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VIEWS, NEWS AND INTERVIEWS.

Many of the readers of the ELECTRICAL REVIEW will remember the projector which Mr. L. H. Rogers installed on top of the Pulitzer Building, in New York city, to throw portraits and advertising signs on the clouds. In speaking of this apparatus the other day, Mr. Rogers stated that the apparatus was all right, but that it couldn't work without clouds. He waited 45 days in New York for a cloud to show up, and then when it came it was so thin the sign went right through it. Mr. Rogers received, a short time ago, an offer from the Russian state officials to install his projector apparatus in Moscow during the ceremonies attendant upon the coronation of the Czar. It was intended to throw various coats-of-arms and insignia upon the clouds by means of his projector. The money consideration was very tempting, but the time required to ship the apparatus to Moscow was too short to permit of its being used. "And then, besides," said Mr. Rogers, "how did I know they have any clouds in Moscow?"

The death of Henry C. Bunner, editor of *Puck*, which occurred at Nutley, N. J., on May 11, removes from the literary world one of the few truly genuine humorists. In his work Mr. Bunner exhibited a rare combination of pathos and humor, which has and will continue to delight and amuse thousands of readers.

Mr. H. L. Shippey, secretary of the John A. Roeblings' Sons Company, the well known wire manufacturers, and builders of the Brooklyn Bridge, recently returned from an extensive trip to South Africa, where he was at the time of the Jameson raid. Dr. Jameson and his companions were in jail at Pretoria and Mr. Shippey did not meet them. He saw Cecil Rhodes and became well acquainted with Mr. Charles Leonard, the president of the Transvaal National Union. Mr. Shippey said:

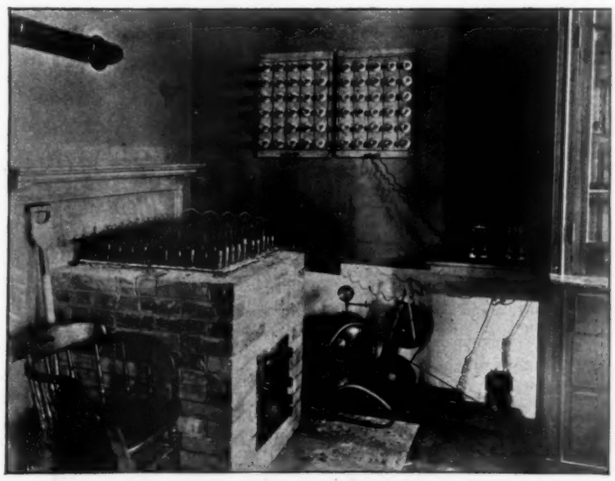
"I spent several weeks on the same ship with Mr. Leonard, and, as you know, one gets to know a man at pretty close quarters on board ship. I formed of Mr. Leonard the opinion that he was as sincere, honest, upright and straight as any man I ever knew. I formed the highest opinion of his integrity and probity."

For the Boers Mr. Shippey had little good to say.

"They are sneaky fellows, who would as soon stab you in the back as not," he declared. "I didn't like them at all. They make English-speaking people as uncomfortable as they can all the time. They are overbearing, arrogant and not to be trusted. Traveling from Cape Town to Johannesburg, I was thoroughly searched, and the Boer officials make no attempt to show one even ordinary courtesy. The feeling is very strong, not only against the English, but against English-speaking people, such as Americans or Australians. I had to get a passport, an elaborate document, to prove my identity before I could go through the Orange Free State."

The London *Electrical Review* recently printed the following: "We have long been impressed with the importance of the field for electrical enterprise that is gradually opening out in Australia and New Zealand. Edison has, according to the *Sydney Telegraph*, commenced operations in that immense district, and, doubtless, being convinced that matters should be stirred there as soon as possible, he has formed, or has arranged with others to form, the Australian Edison Electric Company, for the purpose of handling the whole of his inventions throughout Australia." When the above paragraph was shown to Mr. Edison he said it was news to him.

As already announced in the ELECTRICAL REVIEW an unfortunate accident happened last week to Prof. Elihu Thomson, of Lynn, fracturing the bone of his leg just above the ankle. Although not necessarily serious, it will delay the professor's work considerably. He has been an enthusiastic investigator of the Roentgen discovery, and after the fracture was set had an X-ray picture taken of it. The result was very satisfactory, showing the surgical adjustment of the bone to be most perfect and only a fine line showing the break. Another picture will be taken with an improved Boston tube immediately, and even clearer results are expected. He is at present at his residence, at Swampscott, Mass.



VIEW IN THE LABORATORY OF DR. W. W. JACQUES, SHOWING HIS APPARATUS FOR THE PRODUCTION OF ELECTRICITY DIRECT FROM COAL.

The Jacques Carbon Generator.

In the ELECTRICAL REVIEW of a few weeks ago was given a description of an electrical generator devised and patented by Dr. William W. Jacques, of Boston, in which electrodes of iron and carbon were employed with an electrolyte of melted caustic soda. The carbon is the soluble element; it is claimed for this cell that it is highly successful in operation and caps the climax of the electrician's dearest hopes for the past 15 years in giving the public a practical coal battery. In the REVIEW article above referred to the prior efforts of Jablochkoff and others in this art were adverted to, and the fact noted that nothing commercially serviceable and cheap had been produced. It is claimed that Dr. Jacques's generator is in no sense a *battery*, as the electrolyte of fused caustic soda does not attack the carbon except in the presence of air. It is not apparent how the apparatus can operate at all unless it is by galvanic action, though, of course, the presence of air may be required to maintain a constant action, since the very nature of electrolytic conduction is galvanic and decomposition must take place as a necessary prerequisite before current can pass from pole to pole. In an elaborate article in the *Boston Herald* of May 11, it is stated that 100 cells in series, comprising iron pots one and a half inch in diameter and 12 inches deep, each containing a cylinder of carbon, maintained thirty 16-candle lamps burning at full brilliancy, and used eight pounds of coal in 18¾ hours, giving a current of 90 volts and 16 amperes, and realizing 82 per cent of the theoretical efficiency of burning coal.

Professor Charles R. Cross is said to have indorsed these tests. These are altogether astonishing results, if, as stated, but a small percentage of the energy of the coal used is required to maintain the apparatus hot enough to keep the soda in fusion. An illustration of Dr. Jacques's apparatus in his Boston laboratory is presented on this page.

LONG-DISTANCE TELEGRAPHY.

AN INTERESTING EVENT AT THE ELECTRICAL EXPOSITION.

A very interesting exhibition of long-distance telegraphy was given at the Electrical Exposition, New York city, last Saturday evening. About 10,000 persons witnessed the event. The wires of the Postal Telegraph-Cable Company and the Western Union Telegraph Company were placed at the disposal of the Exposition officials for the occasion. At 8.34 P. M., Dr. Chauncey M. Depew sent the following dispatch to Mr. Edward D. Adams, President of the Niagara Falls Power Company:

"God creates, nature treasures, science utilizes electric power for the grandeur of nations and peace of the world."

This message was transmitted by President A. B. Chandler of the Postal company, who sat on one side of the main balcony, and was received by Thomas A. Edison, who sat at a telegraph instrument on the opposite side of the balcony. The message took the following route: From the Industrial Building, New York city, through Meadville, Pa., Chicago, Kansas City; westward from there by the Santa Fe Railroad telegraph lines to Albuquerque, New Mexico; westward from there by the Southern Pacific lines to Mojave Junction, to Los Angeles and San Francisco; northward from there by the Pacific Postal Telegraph lines to Portland, Oregon, to Vancouver, B. C., and from there eastward by the Canadian Pacific lines, via Winnipeg, to Montreal, and from there to the cable hut at Canso, Nova Scotia. From there the message crossed the Atlantic to London, and was immediately sent back through the Commercial Cable Company's lines to the cable hut at Rockport, Mass.; from there to the office of the Cable company in New York, at Broad and Wall streets, and from there to the Industrial Building, where it was received by Mr. Edison. The time occupied in the transmission of the message was four minutes. Mr. Edison commenced to receive before Mr. Chandler had finished. There was only one relay between New York city and Canso, and that was at San Francisco.

The answer to this message was sent by Mr. Adams to Dr. Depew as follows:

Mighty Niagara, nature's work, serving man, through the world's electric circuit, proclaims to all peoples, science triumphant and a benevolent Creator.

This answer followed the original message right around instead of being sent in the reverse direction. These messages were also sent from London over the Eastern Telegraph Company's system to Tokio, Japan, and returned from London to New York via Rockport. The trip to Tokio embraced a distance of 27,500 miles and the messages were 50 minutes in transit. When the messages were started and received the fact was announced by the firing of cannon on the roof of the Industrial Building. During the time consumed in the sending of the first message from New York Dr. Depew delivered an address in the course of which he said:

The fables of antiquity are the facts of to-day. Jupiter and Hercules, Apollo and Minerva are commonplace persons when compared with Morse and Edison, with Bell and Tesla. The imagination is paralyzed and the mind appalled in contemplating the endless centuries during which the boundless treasures God and nature had stored for the uses of mankind were left undiscovered and unknown. It was reserved for the Nineteenth Century, and for the second half of it, to wrest from the earth, the water and the air the potential and elemental powers which have rescued and regenerated the world.

This Exposition illustrates another beneficent advance in electrical development. It suggests an opportunity to escape from territorial limitations of coal and the prohibitive cost of transportation. Wherever there are mountains and lakes there is water-power. That this power can generate electricity has been known, but its usefulness has been handicapped because the mill and factory could not be readily transplanted. The most sublime concentration of continuing force in the world is Niagara Falls. After the unveiling of the Statue of Liberty Enlightening the World, which had been presented to us by the French Republic, I took the representatives of the French Government to Niagara Falls. When they saw it their feelings were aptly expressed by Admiral Jouett, who exclaimed with dramatic earnestness: "I have seen all the natural wonders of the globe, and this surpasses them all. If there shall ever be an exhibition of the universe, when the stars and planets contribute their best, the earth shall send Niagara Falls."

Telegraph Poles Aid Police.

As will be remembered by those of our readers acquainted with the early history of telegraphy, the capture of a criminal through a message sent by the newly invented apparatus did a good deal towards bringing the telegraph before the authorities, says the London *Electrical Engineer*. Since then very many gentlemen urgently "wanted" by the police have been secured by its means, so that there is reason to believe that electrical progress has always been regarded with a little favor in criminal circles. The final step was thought to be reached when electrocution was adopted in America. The Liverpool police have, however, added another round to the ladder, and at the same time have outrivaled the most elementary prison arrangement described by Mark Twain. Two men were recently discovered in Liverpool while in the act of removing the gas-pipes and internal fittings from some unoccupied buildings. An exciting chase ensued over the roofs of a high warehouse and other buildings. One man was caught and handcuffed to a telegraph post, the two policemen being thus free to chase the other man, who was eventually caught. The remarks of the man as he remained embracing the telegraph post are not recorded, but we understand that they took the form of a petition to the government on the advantages of underground wires.

Weston Engine Co. Burned Out.

The plant of the Weston Engine Company, at Painted Post, N. Y., was destroyed by fire on May 16. Nearly all the plans and drawings were burned and 400 men are thrown out of employment. The loss is $80,000, with $40,000 insurance.

Inventor Burton.

A Boston news dispatch states that the English patent office, after a long contest, has declared George D. Burton, of Boston, to be the inventor of the method and process for electric liquid metal heating and smelting.

Mr. Will F. Conant, secretary of the Public Lighting Commission, of Detroit, claims that the cost per month of each of 1,492 arc lamps run from the city's plant is $5.85, as against $11.15 per month when contractors were doing the lighting.

THE ELECTRICAL EXPOSITION.

FEATURES OF THE SHOW.

The Electrical Exposition closed another week with a large daily attendance and a continuance of public interest. There are some half dozen attractions that seem to appeal most emphatically to the public mind, notably the Edison X-ray exhibit, Mr. D. McFarlan Moore's vacuum-tube lighting, Dr. Max Osterberg's illuminated diamonds and laboratory exhibit, and last, but far from least, the hearing of Niagara's roar by telephone. The Erie Canal model is also constantly surrounded, as is the electric cooking booth. Of course, the substantial exhibits on the power floor and on the main floor are of particular interest to electrical visitors, and from time to time names are reported from far off States of gentlemen who have traveled several thousand miles to discover the latest things in electrical progress. One remarkable fact, as showing the removal of the meretricious influence of "death dealing electricity," should be recorded. In the dark room of the Edison X-ray exhibit, a gentleman was taken with a fit and quietly fell down in the darkness. Some one stumbled over him and he was discovered and his condition promptly attended to. Nowhere appeared an intimation that he had been shocked by electricity. If this had happened a few years ago, it would have been a very difficult thing indeed to have convinced the public and daily press that the man had not been shocked by a stray electric current.

The Hayden & Derby Manufacturing Company, of New York, are showing the various types of their injectors.

The exhibition of the American stoker, shown by the American Stoker Company, of Dayton, Ohio, is in charge of Mr. Stoddard, the secretary of the company.

The bi-metallic wire samples at the Roebling's booth are attracting considerable attention, and it is evident that the wire men are interested in this new product.

The handsome alternating fans made by the Tuerk Water Meter Company, of Fulton, N. Y., were in charge of the company's eastern agent, Mr. E. B. Latham.

The prettily arranged booth showing corrugated copper gaskets and mineral wool made by the United States Mineral Wool Company is on the main corridor of the ground floor.

The Goubert feed-water heaters and the Stratton steam separators are exhibited on the ground floor by the Goubert Manufacturing Company, of 14 and 16 Church street, New York.

The Ball & Wood Company have set up one of their engines in connection with a Siemens & Halske dynamo. A feature of this popular engine is the new system of self-oiling.

The ELECTRICAL REVIEW publishes several illustrations of the exhibits in this issue, and will present additional ones next week. The names of the exhibitors appear beneath the cuts.

The electric lighting plant operated by a Case engine for steam-yacht lighting and Riker dynamo, shown by the Riker Electric Motor Company, is an excellent illustration of a practical plant in a small space.

Mr. Warren and Mr. Stanhope, of A. K. Warren & Company, of New York, have been frequent visitors. This company's space is filled with armatures and machines illustrating the methods of engine-room repair work.

The exhibit of the Babcock & Wilcox Company, in charge of Mr. Riley, is one of the most important in the steam line. The large booth is filled with a complete set of the parts of the Babcock & Wilcox boiler and a large number of interesting photographs.

The interesting line of electrical specialties made by Huebel & Manger, of Brooklyn, are in charge of Mr. Manger in person and Mr. W. W. McChesney, who has recently returned from a most excellent business trip for the company to the Pacific shore.

Mr. Walter F. Smith, of the United Electric Improvement Company, Philadelphia, was in New York several days last week supervising the arrangement of the company's exhibit. Their line of dynamos, motors and incandescent lamps are shown in a large space on the main floor.

A unique feature of the main floor is the exhibit of the Forest City Electric Company, of Cleveland, showing the roll drop commutator bars made by them. The bars are arranged so as to form a huge sign for "Forest City." Mr. W. B. Cleveland, the general manager of this company, is here from Cleveland to be present at the electrical show.

The booth of the Crouse-Tremaine Carbon Company is filled with an artistic arrangement of their carbon products. Messrs. Crouse, Tremaine and Hart, of this company, were all in attendance at the opening of the Exposition, though the two former gentlemen have returned to Ohio and Mr. Hart remains to receive the friends of the company.

The Brush Electric Company's exhibit, in charge of Col. W. S. Rogers, Mr. Dowd and several other gentlemen of the company, is an excellent illustration of the Brush system of arc lighting. A bank of 80 arc lamps is operated and the most modern types of the Brush machinery are shown. Mr. S. M. Hamill, general manager, who is in the East, is expected to be in New York in the near future.

The telephone apparatus exhibited is that made by the Western Telephone Construction Company, of Chicago; DeVeau & Company, of New York; the auto-telephone interior system made by the Tucker Electric Company and the Simplex Interior Telephone Company, in charge of Mr. Morris, of Cincinnati. The latter instruments are used with the Partrick & Carter Company's annunciators.

EXHIBIT OF THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

The Clonbrock Steam Boiler Company on the third floor, next to the experimental booth for X rays, has prepared a most comprehensive series of photographs of the installations of the Clonbrock boilers, which include a large number of the largest and most modern electric light plants in America. The company has been represented by Mr. Stephen Morrin, Mr. Mason and several other gentlemen of the company.

An interesting episode occurred one evening early in the Exposition between several gentlemen of one incandescent lamp company and one of another as to what constituted a fair advantage in advertising, apropos of certain signs. It was reported to a representative of the REVIEW on the following morning that an ambulance call was hurriedly dispatched, though unnecessarily, as the matter was adjusted without broken bones by the removal of the offending sign.

The exhibition of the Nuernberg carbons by Hugo Reisinger, the importer of New York, fills one of the largest booths in the Exposition building. The space is expensively finished in white and the table, chairs and furnishings carry out well the scheme of a white room. The various forms of the "Electra" for direct and alternating arc lamps and the various other forms of the Nuernburg carbon for electrical use. The house is well represented by Messrs. J. F. Outwater and Frederick Nolker, and Friday evening Mr. Hugo Reisinger, with friends, was a visitor.

The line of steam specialties exhibited by the Ashcroft Manufacturing Company, of New York, is of especial interest to the power element as an illustration of the perfection attained in the delicate instruments for the engine room. The exhibit includes the Tabor steam indicator with electric attachments, McCracken steam traps in operation, the Kayser automatic safety water gauge, inspectors' gauge-testing set, Moscrop recorders, engine room clocks, pressure, vacuum, combination and test gauges, and the Edson recording pressure gauge, the patent for which this company has recently acquired from Mr. Jarvis B. Edson.

Much interest has been manifested in the splendid Root water-tube boiler which the Abendroth & Root Manufacturing Company has placed in position for furnishing power for the building. The two boilers form a battery of 500 horse-power. In connection with this are shown in operation two of the feed-water regulators made by this company and their spiral exhaust piping. One of the sensations of the Exposition is the young lady in gold-braid uniform with "Chief Engineer" on her jaunty cap who watches the valves and orders the stokers, and seems as much at ease in manipulating the big Root boilers as the most experienced engineer.

The Stirling company, of Chicago and New York, have set up one of their modern 100-horse-power tubular boilers and also exhibit the boiler in parts, so that one is enabled to study the construction. They also have a most interesting collection of photographs, showing numerous installations, which include many of the finest power plants in America. In this collection are views of the battery of the Stirling boilers installed in the Detroit Street Railway power house, which is said to be the most perfectly equipped electric railway plant in the world. Mr. Fred A. Scheffler, manager of the New York office of the Stirling company, has personally supervised the preparation of this exhibit.

The exhibit of the Electric Storage Battery Company is attracting its full share of attention. A battery of 128 chloride accumulators in glass jars, erected upon a handsome stand, is operated in conjunction with the Edison system, being charged through a motor booster. The battery has a capacity of 500 sixteen-candle-power lamps. In connection with the battery there is a complete switchboard of white marble inclosed in an oak cabinet. Upon the board are mounted Weston ammeters and voltmeters, charge and discharge switches, end cell regulating switches, automatic cut-outs, etc. The installation is complete in every detail. A portion of the exhibit, which attracts a great deal of attention, is a chloride accumulator of the central station type, the element consisting of 29 plates, 30 inches high by 15 inches wide. These are suspended in a highly finished lead-lined oak tank. The cell is similar to that which is now being installed in several central stations. It has a capacity of 4,260-ampere hours at 426-amperes discharge, or of 3,000-ampere hours at 1,000-ampere discharge. In size and capacity, the cell is a revelation to visitors who have not followed up the developments in storage batteries. The company's exhibit also includes a 21-foot electric launch and an electric carriage, both equipped with chloride accumulators. The carriage is always the center of an interested crowd. Portable batteries of chloride accumulators are shown operating fans and table lamps. The exhibit is in charge of Mr. Charles Blizard, assisted by Messrs. R. W. Rundle and W. O. Knudsen. The models of the Niagara Power Plant and of the Erie Canal are operated during portions of the day from cased chloride accumulators stored with Niagara energy. The current for firing the cannons located at different cities throughout the country, announcing the opening of the Exposition, was also drawn from chloride accumulators.

EXHIBIT OF THE ELECTRIC STORAGE BATTERY COMPANY OF PHILADELPHIA, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

Immediately upon entering the main floor of the exhibition at the Grand Central Palace, the exhibit of the Westinghouse Electric and Manufacturing Company is at once observed. While the company has not made a very elaborate display of the many different systems of electrical apparatus manufactured by them, the machines on exhibition are very interesting and attract a good deal of attention. There are several Tesla motors of different sizes. The largest is a 20-horse-power, two-phase Tesla motor, which runs a 20-horse-power, direct-current generator, and there is a five-horse-power, two-phase Tesla motor and also two self-starting, single-phase motors. One of the latter operates a 24-inch ventilating fan. A large show case is filled with a quantity of different styles of Sawyer-Man incandescent lamps. In the background of the Westinghouse space is a large lamp board on which is demonstrated the operation of the Shallenberger alternating-current meter. The case of the meter has been removed and Mr. M. MacLaren, who is in attendance upon the exhibit, is constantly illustrating to the visitors the operation of this well known instrument by turning on the different lamps surrounding the meter. On a small table are found a number of other Westinghouse apparatus, several coils by which is illustrated the principle of induction and also the Tesla rotary field. Apart from the apparatus in this space there are several Westinghouse machines, especially Tesla motors, distributed throughout the building for the purpose of operating printing presses and other machines. Notably among these is the small Tesla fan motor beneath the middle of the Niagara power plant, which operates the pump that brings the water into this plant, and which obtains its current from the great plant of the Cataract Construction Company, at Niagara Falls. Messrs. A. C. Zimmerman and M. MacLaren are in charge of the exhibit. During the convention of the Electric Light Association Mr. C. F. Scott, the well known electrician of the Westinghouse Electric and Manufacturing Company, and Mr. B. E. Lamme were in attendance. On the first night of the exhibit Mr. L. Bannister, vice-president and general manager, and Mr. W. F. Zimmerman, general eastern agent, as well as Mr. Calvert Townley, the Boston agent, and Mr. Frank Stewart Smith, manager of the Sawyer-Man Electric Company, were also visitors to the exhibition, as was Mr. E. H. Heinrichs, the well known advertising manager of the company.

EXHIBIT OF THE INTERIOR CONDUIT & INSULATION COMPANY OF NEW YORK, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

THE EVOLUTION OF THE ARC LAMP.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW YORK, MAY 7, 1896, BY L. H. ROGERS.

For the purpose for which it is intended to be used, the arc lamp, as we commonly know it, is mechanically and electrically the poorest designed and constructed piece of mechanism on earth.

The author of such a statement could only conscientiously proclaim it upon such an occasion as this, before a body of men who are thoroughly familiar with arc lamps, who can instantly spot the first sign of a lack of logic in the argument which must necessarily follow such a radical statement.

Washington was still alive when Volta, a Frenchman, discovered the energy displayed in the consumption of certain metals when immersed in acids. It was simply impossible for him to have realized at that time what the invention or discovery of the primary battery meant.

A few years after this, in 1802, Sir Humphry Davy connected up a large number of Volta's cells. He connected the positive of one cell with the negative of the next one, the positive of that with the negative of the next, and so on. After connecting about 2,000 cells together thus, in series, he attached a piece of charcoal to the positive of one end of the line and another piece of the same material to the negative of the last cell in the row. Then, first touching the pieces of charcoal together and afterwards drawing them slightly apart, the first arc lamp was produced. The pieces of charcoal were in a horizontal position, and as the heated atmosphere between the points caused the flame or mass of illuminated particles to bend upwards in the form of an arch, the name of "arch" light was given to this new form of illuminant.

This term has since been changed to "arc."

History gives us no information regarding the importance attached to Davy's new light, by his neighbors, his wife, or even his scientific associates. It is more than probable that all of them looked upon him as a cranky old professor, foolishly wasting his time and money.

Certain it is, that it was utterly out of the question for any one of that time to imagine that before the close of the century Davy's light would become the commercial light of the world.

In fancy, I lead Davy through the city of Philadelphia, with her streets illuminated by 6,351 arc lamps—the best lighted city on earth—and try to catch some conception of his thoughts as he realizes what his two pieces of charcoal have done for mankind.

It requires 1896 to appreciate 1802.

Some one has said that Faraday was the greatest discovery of Davy's. It must have been that Davy's teachings found good and fruitful soil when instructing his youthful pupil.

It was in 1832, three years after the death of Davy, that Michael Faraday discovered the principles of electro-magnetic induction.

This was a giant stride in the ultimate development of the arc lamp, for the reason that by the applications of these principles the modern dynamo was born. What Faraday did for the world can better be understood if we can imagine primary batteries of equal capacity and power, in lieu of all the dynamos now used for arc and incandescent lighting. The contemplation is sufficient to cause us to love Michael Faraday.

In place of the large number of troublesome and cumbersome cells, the electric potential or energy necessary to maintain an arc between the two pieces of charcoal was now generated mechanically, rather than chemically, with one piece of machinery, rather than a large number of acid-slopping jars.

No sooner had Faraday announced his discovery, than scores of inventors and experimenters began to construct and perfect dynamos. Some great mind like Faraday, or Roentgen, lets down the bars to the Elysian fields, and thousands rush in and stake out all the choice corner lots. These swift-footed inventors, however, are necessary to the evolution of an industry.

Beginning with 1832, one dynamo followed another in rapid succession. Each successive machine embraced some new device or new idea overlooked in its predecessor.

Improvements also began to be made in the device which transformed the electric energy into light. Davy's light, although blinding to the eye, became wearisome, simply as an experiment. It was found that the pieces of charcoal were gradually consumed as they were burned—the one attached to the positive end at the rate of about twice that at the negative end. This lead to the necessity of providing some means of feeding the pieces of charcoal towards one another as they wasted away. The pieces of charcoal themselves were improved. They were hardened and baked, and therefore called carbons.

Thus began the arc lamp on its long, rough journey towards perfection. The first efforts were very crude. The electric current passing through the lamp was utilized to cause a screw to revolve slowly. At the end of this screw was attached the positive carbon, which in this manner was fed towards the lower or negative carbon.

It is easily seen that the nearer the carbon points approached each other, the less became the resistance and the greater became the flow of the current. Likewise, the greater the distance between the carbon points, the greater the resistance and the less the flow of the current. This ebb and flow of the electric current provided magnetic power of varying strength, which was early seen could be utilized to operate the mechanism to feed the positive carbon. The disadvantage of this, however, soon manifested itself in the fact that as the current was augmented and diminished by the proximity and separation of the carbon points, the current in the line itself was proportionately affected. This made the operation of two or more lamps on the same set of wires impossible, for the reason that the carbons in the different lamps could not be depended upon to feed at the same instant, as well as the effect on the regulation of the dynamo.

The operation of more than one light from one machine was, therefore, attended with difficulty from the time of Faraday's discovery, in 1832, up to 1875. Some little success was obtained during this period by running a set of wires from the machine to each lamp desired to be operated, though no illuminating to any extent was done in this manner, except as a laboratory experiment.

About the year 1875 it occurred to a young electrician, Charles F. Brush, living in Cleveland, that if he could, construct a device for an arc lamp which would regulate the feeding of that lamp without affecting the main line, it would then be possible to operate any number of lamps on one circuit, as the current momentarily required to operate the feeding mechanism in any given lamp would leave all the others undisturbed. This was a bold idea, and required inventive genius of a high order to carry it out.

Up to this period a magnet had been employed in the lamp mechanism, which consisted of a coil of wire wound around a hollow spool, into which was inserted an iron core. When the current was switched on, the action of the coil was to draw the core into the spool. This movement provided means for raising and lowering the upper carbon. Mr. Brush used two spools for added strength. The normal path of the current was around these two spools (in parallel) to the carbon and down through the carbons and then to the negative terminal. He, however, constructed another possible path for the current. Attaching a wire of quite small cross-section to the main wire, he wound it on the same spools, but in an opposite direction to that of the coarser wire. This fine wire, after leaving the spools, passed directly to the negative terminal, making what was termed a "shunt" around the arc. The effect of this unique arrangement was the same as a controller on an engine. The more current passing through the fine wire the weaker the magnet became, and the all important point gained that each and every lamp was a law unto itself, establishing and regulating the arc, and feeding without influencing any other lamp on the circuit.

The device termed "differential winding," or "feed," was entitled successful, and to Charles F. Brush belongs the credit of first giving to the world commercial arc lighting. He accompanied this invention with one not much less in importance.

He invented a cut-out—a device for cutting out any given lamp, provided any trouble should happen to that lamp, so that it could not burn. This cut-out insured the absolute maintenance of the main circuit, no matter what might happen to any single lamp.

Visitors to the World's Fair in 1893 will not soon forget the impressive exhibit made by Krupp, of Germany, the gunmaker of the world. Here at one side was shown a piece of iron eight inches thick, and there by its side a gun invented for the special purpose of piercing that piece of iron with a projectile. At the next step was seen a thicker or tougher piece of metal with a more powerful gun to pierce it. And thus the race between gun and metal was maintained, until a weapon 35 feet long, mounted upon a carriage which was revolved, lowered and elevated by special machinery, was exhibited, of such power that it could throw a 2,200-pound ball two miles, and at that distance pierce the toughest wrought iron plate 36 inches thick.

In a somewhat similar manner a race has been in progress between the device for generating the electric current and the device for transforming said current into light—the dynamo and the lamp. Volta invents a battery and Davy matches it with his lamp—a light formed between two pieces of charcoal. After 30 years Faraday discovers an entirely new method of producing the electric current, and scores of inventors immediately proceed to improve the lamp to meet the new conditions. For 40 years after this time improvements in the dynamo and the lamp proceed by easy stages, hand in hand, until the invention of the differential winding, which has placed the lamp far in advance of the dynamo. Immediately this winding was perfected, then began the rapid improvement of the dynamo, to meet, if possible, the new and improved conditions brought about by its use. For the past 20 years and more this improvement of the dynamo has been in progress, until to-day machines highly efficient, close in regulation and producing current for 125 2,000-candle-power arc lamps are as common as the poorly constructed, inefficient 16-light dynamos were 20 years ago.

These large machines are wonders in their class. It is possible to throw all of the lamps in or out of the circuit at once, break the main line or, in fact, do anything to break down the machines electrically, and they continue to run, automatically taking care of their load, and without the least hitch of any kind. The efficiency of these machines is in some cases as high as 90 per cent. In short, perfection has been about reached in the arc dynamo.

On the other hand, the arc lamp as it stands to-day is a poor affair compared to what it might be. It is far behind the arc dynamo as regards electrical and mechanical perfection. What was considered good enough or even perfect 20 years ago will not answer to-day. New uses have arisen for the electric light, and its adoption as an illuminant has exceeded any prophecies ever made for it. The dynamo has again more than outreached the lamp, and the time for a new lamp has arrived.

THE ARC LAMP MUST MEET THE DEMAND.

Remember that the title of this paper is "The Evolution of the Arc Lamp," and that evolution denotes a continuous development. Since Brush perfected the fundamental principles of the commercial arc lamp, what has been done? In 1875 the arc lamp was a great ball of wonderment. From 1878 to 1880 a few were induced to really try them practically. During the next decade the mad lighting fever was in full sway, and 250,000 arc lamps had been hung up in the United States by 1890. The manufacturing companies were too busy shipping and collecting to think of anything but of something which would burn. The lighting companies were too busy making contracts with municipalities and supplying the demand for light to ever look to see what was inside the lamp.

But this is the age of close inspection. Municipalities are not paying $350 per year for a 2,000-candle-power arc lamp in 1896. They encourage other companies entering their city limits, and this brings keen and active competition. If competition is not encouraged, or if prices for lighting are not reduced, the "tax-payer"—that tireless individual who never dies—is heard from, and starts the agitation for a municipal plant on the theory of his new discovery that electricity costs nothing to "make."

It is not the purpose here to discuss this swing of the pendulum from too high prices—it has, indeed, swung too far already in the other direction—but it does behoove us to examine closely into the daily expenses and annoyances to which the electric lighting plant is subjected.

There is no business which has developed so rapidly and so radically as that of electric lighting. The frame building, 20 feet square, has been replaced by a handsome brick and iron roofed structure, 150 by 300 feet, and three stories high. The deliberate saw-mill engine, at 90 revolutions, has been replaced, first by the diminutive busy little high-speed engine at 350 revolutions, then by a larger type of the slow-speed engine, and later by a compound

condensing engine at a piston speed of 800 feet per minute. The transmitting devices have been changed from belt to rope, and rope to direct. The boilers have undergone a radical change, and the manufacturer must now guarantee the pounds of water evaporated, per pound of coal, by his make. Remarkable and needed improvements have been made in the dynamo, as we have mentioned. The efficiency has been raised from 50 to 85 or 90 per cent. A 125-light machine gives less trouble and care to run than an old 10-lighter.

In all this development; in this search for high efficiencies; in this attempt to get running expenses down to the minimum; the arc lamp has been overlooked. The most important single piece of mechanism in the entire system, it has been the last to receive serious attention.

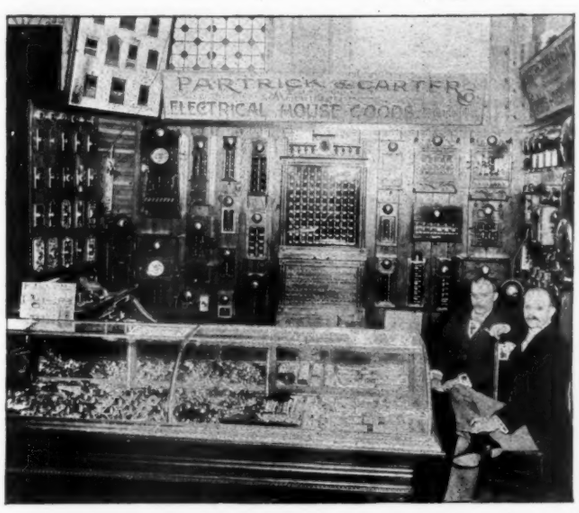
There are 2,711 central lighting stations in the United States, with $320,000,000 invested. The sole and only object of this outlay is to get light. The engines, dynamos, belting, conduits, buildings, are all secondary to the arc lamp. It is the exponent of the entire problem. It is literally in the "eye of the public" day and night. Its lines of—I was about to say beauty, but whoever heard of a beautiful arc lamp? At any rate, it stands against the morning sky or the evening sunset, and, in truth, I hear the public say: "It must be the best the electricians can do, for I have watched for 15 years, but have seen no change; they are all alike in their hideousness."

And now let us look at the subject squarely. Let us hold the arc lamp up between the fluorescent screen and the Crookes tube, and in the light of X-ray, 1896 knowledge, examine the arc lamp hanging in our streets.

We find a device, 50 to 60 inches long, made of long tubes or chimneys, a sheet-iron drum, long side rods, and at the bottom a globe-holder. We can see Davy's two pieces of charcoal; one is 12 inches long and the other six. The rate of consumption has not changed. We realize that the useful length of this lamp is the vertical length of the carbons. Dividing 18 inches by 50 inches, we find that the useful length of this device is only 36 per cent of its total length. The statement may be made by some enthusiastic observer that there are two pairs of carbons—one pair alongside the other—but he must not forget that with our improved eyesight in 1896 we can look clear through the device and see not only the skeleton, but the marrow in the bones.

These carbons are fastened firmly in their respective holders, and the holders are rigid. The burning of the arc causes the carbons to point up quite decidedly. When the current is shut off momentarily, these points fall together and it very often happens slip by each other and wedge. When the current is again sent through the coil, its lifting power is not sufficient to pull the carbons apart, the lamp is rendered utterly useless, the policeman reports it out, and a deduction is made from the bill of the lighting company to the city. To prevent these deductions amounting to more than the original bill, a corps of patrolmen are engaged, whose business it is to watch the lamps all night long, to prevent them going out, as a nurse would watch a sick child.

We find the interior of the devices full of springs, some of them with ratchets and cog wheels, some with six magnets or coils,—all with three or more—springs without number and of every size, regulating devices, auxiliary levers, light and flimsy pieces of every shape and size, the device for gripping the rod—in most cases an annular ring gripping the carbon rod by tilting so that its knife-edge holds on the side of the rod, the current being conducted to the carbon rod by means of a sliding contact—delicate brushes against which the carbon rod rubs as it feeds the carbons downwards, cut-out spools which have little side shows of their own with independent armatures and additional coils of wire, carbon rods sticking away up into the dark recesses of the chimneys—rods which must be carefully housed and carefully cleaned with crocus cloth each day. We notice also that for three or four inches above the casing the rod can not be cleaned by the trimmer; it therefore becomes spotted; a bit of weather or a bit of dust changes the nature of the brass, and the current-carrying brush, when it reaches this spot, does not make a good connection; a little blister is formed, which in turn blisters the surface of the brush, and this in turn blisters the rod the entire length until crocus cloth is powerless to smooth it. The lamp then must come in, for in the meantime many other little things have happened, and nothing but a thorough overhauling will put the lamp in good condition again.



THE EXHIBIT OF PARTRICK & CARTER COMPANY, OF PHILADELPHIA, AT THE NATIONAL ELECTRICAL EXPOSITION, NEW YORK CITY.

It would require a volume to recount the details of the troubles that are occurring every hour in every lighting plant on the face of the globe. You, who are within reach of my voice, know too well that your arc lamps give you more trouble than all the rest of your apparatus combined. These troubles have come upon you so gradually, however, that you have become accustomed to them. It seems that some station men actually delight in keeping a force of men repairing old lamps, and a horse and wagon busy hauling them in and taking them out again.

Alexander Dow, electrician for the city of Detroit, connects four 100-light dynamos to one engine, for the reason, as he states, that the ratio of troubles is four to one. I wonder how many dynamos would be connected to each arc lamp, or arc lamps to dynamos, provided the number were dependent on the ratio of troubles?

And now we have reached the year 1896; we have given the arc lamp a 20 years' tussle, and our troubles are increasing rather than diminishing. The lamp cuts the same kind of a figure against the sky as it did in the year 1875. Many details have been added in the interior construction, more magnets, and more springs, and more cut-outs, and more chimneys, and less glycerine—but I do not think the statement can be denied that not one single idea of great merit has been added to the arc lamp between 1875 and 1895.

If this be true, is it not time to consider the question seriously? Are we to give up the question and acknowledge that hanging on our streets is the world's best effort for the distribution of light through the medium of the arc lamp?

Is evolution to be the password to progression in all the arts; in fact, in everything except the arc lamp?

To return to the opening sentence of this paper, "For the purpose for which it is intended to be used, the arc lamp, as we commonly know it, is, mechanically and electrically, the poorest designed and constructed piece of mechanism on earth."

I am not here to decry the lamp of any manufacturer. It is, however, pertinent to say that any lamp which will allow the carbons to slip by or wedge, under any circumstances, is mechanically imperfect. It is an inherent defect in the lamp, and the damages or outages should be charged to the manufacturer of the lamp. What mechanism has determined that the proper way to hold two slim, sharply pointed pencils in a coaxial position is to fasten them rigidly at their extremities, 18 inches distant, and then depend on their sharpened points nosing each other correctly? A very much better way would be to leave the carbon-holder loose and free, centering by guiding the carbons near the arc. This would make trimming a very easy matter, and admit of cross-eyed men being employed. On second thought, however, we run immediately into difficulties, for, as we can not change the rate of consumption of the positive carbon, the arc would soon reach one of the guides and burn it away. This would then require a lamp with a stationary arc, and that would require carbons of different diameters—upper and lower—and that would mean a great deal of thinking for the inventor and manufacturer, and so the lamps go out; and the station manager, believing that the arc lamp has been fully evoluted, keeps sending his orders to the manufacturer, and the manufacturer will never improve as long as he can fill his orders with old-style apparatus.

A sliding contact is a poor arrangement in an arc lamp. It has been tried as thoroughly as any idea ever could be tried. It is the direct cause of the roughness of the rod. The resistance of the contact is too easily increased by the presence of a little dust. The sliding contact in the arc lamp must go.

The carbon rod itself is a troublesome institution. With an annular ring for a clutch, it must be kept in a uniform, polished condition, or it will give trouble. It is responsible for the unsightly hideous chimneys, which ought not to be in sight and yet which can not be draped. As we are building a new lamp let us dispense with the carbon rod altogether. We can then cut off the chimneys and shorten up the lamp. Then we can, without much trouble, parallel the carbons with the operating mechanism and increase the percentage of useful length to total length to at least 80 per cent. With a short lamp we can make a casing of light cast-iron in such shape as to avoid the necessity of a hood. We can also increase the carbon length, and if we do this we can choose our own size of carbons; that size for upper which will produce the largest crater, and that size for lower which will best let the light out.

Thus we come back and meet, but overcome, our first difficulty. We construct a focusing lamp, and this leads us to the thought that there is only one correct position for the arc inside the globe, anyway, and that the arc should be stationary. If we hang the upper carbon on a chain suspended over a shieve, and attach the lower carbon to the lower end of the chain, we can, with proper adjustment, accomplish many things. As the upper carbon feeds downwards, as it is being consumed, the chain can be of equal weight—inch for inch therewith. Therefore, when an inch of upper carbon has been consumed, and its weight taken from the cross-head, an inch of chain has been added, and the armature remains in the same plane between the pole-pieces of the magnet as before. This is an absolute necessity where the same difference of potential is required throughout the entire range of burning.

Thus we are not restricted by the weight of the carbon, and can use whatever size is most suitable. It having been demonstrated that with eight, nine or ten amperes 2⅝-inch carbon will produce a larger crater and give more initial light than any other size, it remains only to determine the length necessary for burning 14 to 16 hours. This length has been found to be 14 inches. With an upper carbon of ⅝x14 inches, we find that ½x12 negative plain will burn an equal length of time, leaving an equal stub and keep the arc practically in the same position during the entire run. This small lower carbon will let out the intense light in the crater of the upper, the increase of light at 45 degrees being something which would astonish most experimenters.

We must not forget that 320 millions of money is invested in the central stations alone in the United States simply to get light, and more light with the same expenditure of energy should be a welcome statement by those interested.

By quotations from all leading carbon manufacturing companies of the country, the point is discovered that a pair of ⅝x14 and ½x12 carbons is the cheapest possible combination for 14 to 16 hours' burning. Any one can test this point. It is simply the price of one ⅝x14 plain and one ½x12 plain carbon against three ½x12 plain or $\frac{7}{16}$x12 copper-coated carbons. I have quotations in my pocket which will make a difference of $2.50 per lamp per year, assuming the full number of burning hours nightly, in favor of the ⅝x14 and ½x12 carbons.

Again, a ⅝ upper and ½ lower, loose at the joints and guided near the arc, will absolutely prevent wedging

(Concluded on page 266.)

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***CHANGES** for advertisements must be in this office by Friday noon for the following week's issue.*

***NEW ADVERTISEMENTS** should be in the office not later than Saturday noon to insure publication the following week.*

NEW YORK, MAY 20, 1896.

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Have you ever noticed what a *penchant* electrical men possess for shaking hands with people they meet? One man at the Electrical Exposition the other night was observed to shake hands with 12 men in as many minutes. Promiscuous hand-shaking is a waste of energy which electrical men, as engineers, should be the first to recognize.

TESLA'S ACHIEVEMENTS IN VACUUM TUBE LIGHTING.

The ELECTRICAL REVIEW has from the outset closely followed the promising work of Nikola Tesla. We had the privilege of announcing in 1886, for the first time, Tesla's investigations in a system of electric lighting. Early in 1888 we were the first to announce his epochal discovery of the multiphase system of power transmission, and since that time it has been our pleasant duty to keep our readers well informed on the various subjects of his important researches, of which we only mention his latest contributions to the great discoveries of Roentgen, which were exclusively published in our columns. It is, therefore, no small satisfaction for us to now first record another significant advance of this indefatigable worker. Ever since Tesla showed in his memorable lecture before the American Institute of Electrical Engineers, five years ago, the fascinating experiments with vacuum tubes, he has untiringly labored on, simplifying and improv- his methods, not for a moment diverted by other tasks—nor even discouraged by so great a calamity as the recent destruction of his laboratory—from the problem of producing an efficient and practical system of electrical illumination.

No more impressive result of Tesla's earnest efforts could be shown than that which is outlined in our present issue. The portrait of the great inventor, which, especially in view of the extraordinary way in which it was obtained will not fail to interest the scientific world, is a striking illustration of what he has done. Surely, since he has produced a vacuum tube which is capable of supplying any volume of light desired, even more than a powerful arc light, we can not hesitate to express our positive conviction that the introduction of a more perfect illuminant is near at hand.

The observing editor of the *Morning Advertiser* has noticed the dimness of the Liberty torch on Bedloe's Island and is inclined to blame electricity for it and suggests a visit of electrical experts to see what is the matter. It doesn't require any expert to suggest a remedy. What is needed is a little more liberality on the part of the penurious United States Government in the matter of coal. A little more coal in the grate, a little more steam in the boilers, a few more revolutions per minute of the dynamo's armature, and the light will shine bright again. It is really a shame that, after accepting this plant as a gift, the government should pay so little attention to its proper care.

THE SIZE OF ELECTRICAL BOOKS.

In our issue for April 15 we expressed an opinion that it would be greatly to the advantage of the busy electrical man if publishers would make electrical books of a size to slip easily in one's pocket. Our esteemed contemporary, the London *Electrical Review*, takes a similar view of the case in its issue for May 1, as follows:

The electrical man has hardly time to sneeze nowadays, so busy is he running his plant or carrying out extensions. Therefore, ten chances to one, he will not be able to read cumbersome books, however important the subject, and be his desire ever so ardent. The tendency in electrical matters is towards conciseness, and it must be so in publications in particular to meet the requirements of such a man as the electrical engineer. As well as conciseness, this all-important being needs compactness; and this is a point which publishers of technical works should take to heart. The smaller the size of an electrical book, the more use it will be, and, consequently, the larger its sale. What is wanted is not a book the size of a family Bible, but one in size of page and cover similar to a pocketbook, so that when these odd moments occur the engineer can take it from his pocket and digest a little at a time, and think it over as he goes about or when his attention may not be specially upon his work. Publishers should make a note of this point. It is worth considering.

THE FINANCIAL SIDE.

Electrical matters were very quiet in financial circles this week, about the only interest being the annual meeting of General Electric, held at Schenectady on Tuesday, the 12th instant. That stock was steady around 34, and the bonds sold at 90¼. Edison Electric Illuminating of New York bonds sold from 103 to 104.

I attended the General Electric meeting with the expectation of hearing from the preferred shareholders in the matter of a correction of the capital impairment and the payment of accrued dividends. Not a word was said upon the subject, and only routine business was transacted.

I learned from an unquestioned source that the next move that will be taken, with a view of correcting the capital impairment, will, in all probability, be a suit by the preferred shareholders to force the payment of something like 21 per cent dividends, now in arrears. This would result in a decision by the courts as to the company's legal right to pay these dividends.

On the Boston Exchange, Bell Telephone yielded fractionally, to 205¼. Transactions were light. Erie Telephone at 60 and New England Telephone at 90 were unchanged. General Electric preferred was strong, advancing 2 points to 74 on improved prospects of back dividends. In Philadelphia the Electric Storage Battery stocks continued their upward creep. The common is now selling at 35⅛ and the preferred at 36¼. The Pennsylvania Heat, Light and Power Company lost 1 point to 14½. BAIN.

New York, May 16.

TESLA'S IMPORTANT ADVANCES.

HIS REMARKABLE ACHIEVEMENTS IN VACUUM TUBE LIGHTING.

A representative of the ELECTRICAL REVIEW visited the laboratory of Mr. Tesla last week and found him engaged in putting the final touches to certain improvements in vacuum tube illumination. He was enthusiastic as to the results arrived at to such a degree that he expressed his positive confidence as to having made very important advances.

While reluctant to speak at present extensively on the subject of his most recent investigations, he authorized the statement to the effect that he has been most successful in several lines of work he has been following up for a long time, only temporarily interrupted by the lamented destruction of his laboratory by fire about a year ago.

When asked about his often-mentioned oscillator he said that a commercial machine is now being completed with which he expects to show the superiority of this mode of generating electricity.

He further stated with evident elation that in the study of the Roentgen phenomenon he has made great progress, so much so that he is now able to perceive through an Edison improved Roentgen-screen, recently purchased from Aylsworth & Jackson, of this city, the heart of an assistant so clearly as to note its expansions and contractions. In some instances he could locate evident defects in the lungs of a number of persons.

As to his continuous efforts to improve his system of lighting by vacuum tubes, with which he has been identified during a number of years, Tesla said that he has been more successful than he had ever dared to hope. His methods of conversion from ordinary to high-frequency currents are rendered simple in the extreme, the devices are thoroughly reliable and require no attention. Last, but most important of all, he has succeeded in increasing the candle-power of the tubes to practically any intensity desired.

A remarkable and most telling result of the advances he has made in the last direction is a portrait, which he has reluctantly allowed us to use, and which was obtained by *two seconds'* exposure to the light of a *single vacuum tube* of small dimensions. Tesla stated further that photographs obtained by the light of such powerful tubes show an amount of detail which no picture taken by the sun or flash light is capable of disclosing. This feature is only faintly shown in the reproduction on this page. The photograph was made by Tonnelé & Company, artists' photographers, who aided Mr. Tesla in his attempts to photograph by the light of phosphorescent tubes about two years ago.

When asked, Mr. Tesla said, in explanation of the picture, speaking with deep feeling, that the volume he was reading was one of the "Scientific Papers," of Maxwell, given to him as a token of friendship by Professor Dewar; the chair a gift of his warmest friend, Mr. E. D. Adams; and as to the queer coil to his left, Mr. Tesla hesitatingly remarked that it was the object "dearest of all in his laboratory," having been a most valuable instrument in his many-sided investigations.

TESLA IN HIS LABORATORY—PORTRAIT OBTAINED BY AN EXPOSURE OF TWO SECONDS TO THE LIGHT OF A SINGLE VACUUM TUBE WITHOUT ELECTRODES, HAVING A VOLUME OF ABOUT 90 CUBIC INCHES, GIVING APPROXIMATELY A LIGHT OF 250 CANDLE-POWER—PHOTOGRAPHED BY TONNELÉ & CO. COPYRIGHTED BY THE "ELECTRICAL REVIEW."

Mr. Tesla added, good humoredly, that, had it not been for the extraordinary manner in which the photograph was taken, he would not have given this explanation even to such an important personage as the representative of the ELECTRICAL REVIEW.

The *Western Electrician* felicitates itself on getting its issue of May 9 to New York on May 2. This western enterprise is a question merely of dating ahead—and because of the news and up-to-date information that does not, but should, appear appeals solely to the amiable minds to be found in the editorial office of our blue-countenanced contemporary.

General Electric Company's Annual Meeting.

The annual meeting of the General Electric Company was held at Schenectady, N. Y., on May 13. The representation of stock was 201,000 shares. George Foster Peabody was elected a director in place of Thomas K. Cummings, Jr. The balance of the old board of directors was re-elected. Only routine business was transacted and the question of capital impairment was not brought up.

President Charles A. Coffin, of the General Electric Company, was seen by one of the editors of the *Wall Street Journal* recently, and stated that negotiations had been under way for the removal of the company's works from Schenectady, but that these had been dropped for the present. Mr. Coffin further stated that the patent agreement with the Westinghouse company will go into effect June 1. It will not change the style or character of apparatus manufactured at the works in any substantial respect. The patent agreement has been under consideration long enough to warrant the belief that it will result in a considerable increase in business for the two companies and a shade better prices. The directors have not, for various reasons, formulated any definite plan for correcting the impairment of capital. The preferred shareholders have recently taken up the question for formal consideration and it is not impossible that some plan of dealing with the matter may be outlined at an early date.

Mr. W. J. Camp, of Montreal, electrician of the Canadian Pacific Telegraph, was a New York visitor last week, conferring with Electrician F. W. Jones, of the Postal Telegraph.

THE DESIRABILITY OF A STANDARD SOCKET.

TOPIC DISCUSSED BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW YORK, MAY 7, 1896, BY ALFRED SWAN.

The topic which I introduce deals with the vexed question of lamp sockets. Its object is to promote an interchange of opinion on the part of those present who are interested in the subject, and by its discussion before this convention give to the question that status which its importance demands.

This question of the standardization of the lamp socket was recently raised by the *Electrical Engineer* and various letters appeared in the journal on that subject. A notable feature of this correspondence was the preference almost unanimously declared for a particular type of socket because of the comparative cheapness of its lamp base.

The fact that a socket outlives many lamps does, undoubtedly, as things are now, encourage the use of that particular type of socket which is usable with the least expensive form of lamp base, though the socket in question may not in itself be the best or the cheapest.

This fact would seem clearly to indicate that preliminary to the standardization of the lamp socket must be the standardization of the lamp base.

When scientific fitness, due simplicity and point of lowest cost shall have been attained in regard to the lamp base, then will necessarily result a standard socket.

Following, therefore, this line of argument, and concerning ourselves first with the lamp base, let us, with due reference to its functions, consider what we should demand in a standard lamp base.

The elements involved in this question are three-fold—electrical, mechanical and economical.

Good insulating conditions are of the first importance to guard against leakage or other abnormal action in the wires connecting with the lamp.

Mechanical considerations concern the means by which the base is attached to the lamp—as well as the means by which, when so attached, it couples with the socket — the method of coupling with the latter, while insuring a rigid and unfailing contact, should be such as not to put an undue strain upon the lamp.

Cheapness is, of course, a *sine qua non*.

The death rate in lamps being high, and the base, as a rule, not surviving the lamp, obviously the less value we involve in that base the better.

How many of the present types of lamp base conform to these standard requirements ?

What could well be more inappropriate to the delicate structure and graceful form of the lamp itself than is even the best—or, rather, let us say, the least objectionable — of those appendages with which lamps are now encumbered.

(To be concluded.)

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW YORK, MAY 5, BY LOUIS A. FERGUSON.

It is my intention in presenting this paper to treat of acetylene in its commercial aspect as related to the illuminating industry and to attempt no description of its value in the chemical world, as the latter is a field entirely apart from that invaded by this Association and one so comprehensive that it might well be made the subject of another discourse.

The first step in the process of manufacture of acetylene gas is the production of calcium carbide, which is accomplished by the reduction of lime by carbon with the intense heat of the arc in an electric furnace. The chemical equation representing the action is $CAO+3C=CAC2+CO$, the CAO representing the lime, 3C the carbon, CAC2 being the symbol of calcium carbide, and CO the carbonic monoxide. Although several experimenters produced carbide of calcium and carbide of sodium and from these acetylene gas many years ago, the first production of carbide of calcium on anything like a commercial scale was made by Mr. T. L. Willson, at Spray, N. C., while endeavoring to produce the metal calcium in the electric furnace. It was my good fortune to have visited with Mr. Willson his plant at Spray, and there carried on experiments in the manufacture of the carbide of calcium and the production therefrom of acetylene gas, and perhaps a few words in description of the apparatus employed may be of interest to you.

Spray is a beautiful little spot about 25 miles southwest from Danville, Va., and about two miles from Leaksville, N. C. It is reached from Danville by a narrow-gauge road, operated by negroes, the locomotive boiler being fired by wood in true primitive fashion, the roadbed hardly being the equal of the trunk lines between New York and the West. The carbide plant is located alongside of a small stream which has quite a fall at this point, the power of the fall driving a Leffel water-wheel, to which are belted two General Electric Company's 120-kilowatt alternating-current dynamos, built for 60 cycles per second. In Mr. Willson's original work he used a direct-current dynamo of his own construction, but this was abandoned later and the larger alternating-current machines purchased, so as to enable the experiments to be carried on upon a larger scale. It was also imagined that an alternating-current dynamo would give better results, it being claimed that the alternating current would keep the mixture of coke and lime stirred up about the arc. This, of course, was a fallacy, the real value in the use of the alternating-current machines, as compared with the original ones built by Mr. Willson, lying in that, no commutator being required, it was much easier to regulate under the varying conditions of the arc, and there was an entire absence of sparking, which was a destructive feature of the original dynamo. The alternators are built for 1,000 volts, arranged to run in parallel, and transformers are used to bring the pressure to 100 volts. The switchboard for the dynamos is provided with ammeters and voltmeters for each dynamo, so that the output may be accurately determined. From the switchboard large cables, capable of carrying 1,000 amperes, run to each of two furnaces, which are built of brick, the dimensions of the furnace being approximately three feet square and eight feet high. Each furnace is provided with a flue to carry off the gases of reduction. In the floor of each furnace is a carbon plate to which the cables connect, this plate constituting one pole of the arc. The upper carbon for the arc consists of six carbons in one cast-iron holder, each carbon being four inches square in cross-section, and 36 inches long and weighing each 35 pounds. The carbons are raised and lowered by means of a chain winding on a drum operated by a wheel in the dynamo room, so that the energy expended in the production of the arc is maintained constant during the process of manufacture of the calcium carbide. Having thus seen the method of producing the electricity and its application to the electric furnace, we will now pass to the process of manufacture of the carbide. The carbon used in the process at Spray is Pocohontas coke, having a nine per cent ash. The coke is conveyed to a hurricane mill, where it is ground to a fine powder and then put with the lime into a revolving mixer, by which it is thoroughly mixed and prepared for the electric furnace. Theoretically the proportions of lime and carbon necessary for the production of 100 pounds of calcium carbide are 87½ pounds of lime and 56¼ pounds of carbon. These combine, according to the formula before mentioned, $CAO + 3C = CAC2 + CO$, 37½ pounds of carbon combining directly with the metal calcium forming calcium carbide, and 18¾ pounds combine with the oxygen of the lime, forming carbon monoxide gas, which passes off from the furnace.

Nearly 12 months ago, on May 15, 1895, at Spray, N. C., with the described plant, the writer, together with Mr. George O. Knapp, of Chicago; Mr. T. L. Willson and Major Morehead, of Spray, N. C., carried on a test to show the actual production of calcium carbide per horse-power per day and the volume of acetylene obtainable per pound of carbide. The coke and lime were prepared in the manner described, the mixture containing 800 pounds of air-slaked lime and 390 pounds of powdered coke, making the total weight of mixture 1,190 pounds. Of this mixture 180 pounds were unused, leaving 1,010 pounds which were delivered to the furnace. The test run was for a period of three hours, during which the mixture was fed into the furnace by shovel as required, and the material stoked regularly. The current used varied from 900 amperes to 1,200 amperes as extreme limits, but being kept very regularly at about 1,000 amperes, the voltage varying from 90 to 104 at the extreme and being kept fairly constant at 100 volts. Readings were taken approximately every 10 minutes during the test, and from 23 readings the average showed 1,000 amperes and 100 volts, or an average consumption of energy at the terminals of the furnace of 100 kilowatts during the entire run of three hours.

After the current is turned on and the arc made, the carbide begins to form on the bottom of the furnace under the upper carbons in the shape of a block, and as it forms it is necessary to raise the upper carbons to maintain the proper arc, the current passing from the carbons in the form of the arc to the carbide below, the latter now constituting the other pole of the arc and conducting the current to the plate in the bottom of the furnace. The production of the calcium carbide is by the heat of the electric arc alone and not by electrolysis, the temperature of the arc being in the neighborhood of 3,500 degrees to 4,000 degrees Centigrade, while that of the ordinary smelting furnaces ranges from 1,200 to 1,500 degrees Centigrade.

At the end of the run the current was cut off, the furnace was allowed to cool down and the product and unused material removed and carefully weighed. During the production of the carbide some of the mixture is lost by passing up the chimney with the gases of reduction, which burn with wild sheets of flame, increasing with their hissing the already deafening roar of the immense alternating-current arc. The weight of the calcium carbide actually produced in this test was 139 pounds, the unused material amounting to 607 pounds, to which must be added the water contained in the lime—165 pounds—making the total unused material 772 pounds. The weight of the mixture delivered to the furnace was, as stated before, 1,010 pounds, so that the actual weight of mixture consumed and lost in the process of manufacture of 139 pounds of calcium carbide was 238 pounds. The efficiency of production, therefore, would be the weight of carbide produced divided by the weight of mixture used up, or 139 divided by 238, which gives 58.4 per cent as the efficiency of production.

The next step is to calculate from the results of the tests the amount of carbide produced per kilowatt hour. We have seen that the average value of the energy expended in the production of the carbide was 100 kilowatts, and that we produced 139 pounds of carbide in three hours, or at the rate 46⅓ pounds per hour. Therefore the carbide produced per kilowatt hour would be 46⅓ divided by 100, which is $\frac{46}{100}$ pound, or at the rate of 11.12 pounds of carbide per kilowatt per 24-hour day, or 8.3 pounds per horse-power per day of 24 hours. A sample of this carbide produced, weighing 34.1 grammes, was then taken and the acetylene gas formed by adding water, and the gas evolved, measured by means of special apparatus, showed a result of 5.24 cubic feet of acetylene gas per pound of carbide, after making the proper temperature and barometric corrections.

Having thus seen the quantity of calcium carbide produced for each kilowatt hour of energy consumed and the value of the carbide as a producer of acetylene, we will now take up the method of production of acetylene from the carbide and consider some of its properties before determining the cost of production of the carbide.

Acetylene is produced from the calcium carbide merely by the application of water, the action being shown by the equation $CAC2 + 2H2O = CAOH2O + C2H2$. When the carbide is thus brought in contact with the water the acetylene gas is given off rapidly, and its presence is distinguished by its very pungent odor, somewhat resembling phosphorus. When lighted it burns with a deep yellow flame, and is extremely sooty, but when generated at an even pressure and burned with proper burners, designed for the use of acetylene, it gives a beautiful white light. The acetylene flame so used is exceedingly tenacious, and it is almost impossible to blow it out, which may be considered as an advantage in hotels and other places where rural gentlemen occasionally take up their abode.

A simple method of generating acetylene from the carbide is to take an ordinary chlorine generator and place within some lumps of the carbide, arrange a glass funnel so that water may be admitted to the interior of the generator, connect the generator by means of a rubber tube to a gasometer, the outer tank being partially filled with water; from the gasometer above the water line another tube connects to a gas pipe with a set of burners attached. Water is then poured gradually in small quantities through the funnel into the generator and upon the carbide. The acetylene gas thus generated passes through the tube to the inside of the gasometer and lifts the gas-holder, the position of the latter changing with the quantity of gas generated. The gas is then delivered from the holder by means of the rubber tube to the piping and burners. As the gas is consumed, the holder lowers and a fresh supply is generated by admitting more water through the funnel upon the carbide within the generator.

Another method, which is automatic in its action, is to partially submerge a vessel in water, the vessel being open at the bottom and containing the carbide suspended on a screen in the upper part of the vessel. The gas is then drawn from above the carbide, and as long as it is being used the water remains more or less in contact with the carbide, but as soon as the consumption of gas ceases or diminishes, the pressure of the gas forces the water downward into the lower part of the vessel and away from the carbide, thus causing the generation of the gas to cease. An arrangement similar to this is one proposed for country residences.

Acetylene gas may also be used in its liquid form and is prepared by decomposing the calcium carbide with water in a closed vessel and conducting the generated gas under pressure to a condenser where it liquefies and is then drawn off in tanks for shipment and distribution.

Compared with other gases, acetylene has a very high candle-power. Water gas, which is used in nearly all the large cities of the United States for illuminating gas, when burned at the rate of five cubic feet per hour, gives from 20 to 25 candle-power, while acetylene, when burned at the rate of five cubic feet per hour, gives, according to most observers, 240 candle-power, or approximately 10 times the illumination of water gas.

The temperature of the acetylene flame is low as compared with that of water and coal gas—Professor Lewes placing the temperature of the acetylene flame at 1,000 degrees Centigrade, and the coal gas flame at 1,360 degrees Centigrade. It has been stated by Professor Crafts, of the Massachusetts Institute of Technology, that the true relation of the temperature of the present commercial illuminants, when giving the same candle-power, is: Incandescent light, one; acetylene, three, and water gas, nine, showing that the incandescent lamp gives off the least amount of heat per candle-power, while acetylene gives three times that of the incandescent lamp and one-third that of water gas.

Many experiments have been made by noted scientists and investigators to determine the poisonous qualities of acetylene gas. Guinea pigs, dogs and other small animals have been made martyrs to science and subjected to mixtures containing carbonic oxide, which is the poisonous constituent of ordinary illuminating gas, and after their death their blood has been examined and the amount of carbonic oxide absorbed by the blood determined. Grehant made comparisons of carbonic oxide and acetylene, to determine their relative poisonous qualities, upon dogs. In his experiments he used 20 per cent of oxygen in his mixtures, so as to prevent the animals death by suffocation. He added enough Paris illuminating gas, which contains seven per cent carbonic oxide, so as to give one per cent carbonic oxide in the mixture. The dog showed signs of suffering after three minutes, and in 10 minutes the dog was very sick, and

his blood showed 27 volumes in 100 of carbonic oxide. Another dog was subjected to a mixture containing 20 per cent oxygen and 20 per cent acetylene, and the dog breathed without inconvenience for 35 minutes. Upon examination, his blood showed 10 per cent acetylene, less than one-fiftieth of the rate of absorption of carbonic oxide. The mixture contained much more acetylene than that to which a person could be subjected in the use of acetylene as an illuminant, since a leak of the gas would produce an explosion in the room of a dwelling house before the percentage of acetylene mentioned were attained in the atmosphere. Similar experiments were carried on by Brociner, Berthelot and Claude Bernard, and the conclusions of the best authorities indicate that acetylene, when pure, is not poisonous. Berthelot has pointed out that the old method of preparation of acetylene by means of acetylide of copper may contaminate the gas with hydrocyanic acid and thus render it poisonous.

Having seen how the calcium carbide and acetylene are made, and having considered their properties, the question now before us is the cost of producing them. The results of the tests made at Spray, and before described, show that 8.3 pounds of carbide is produced by each electrical horse-power in one day, or .463 pound per kilowatt hour; also, that the efficiency of production was 58.4 per cent. Experience at Spray shows that the carbons used as electrodes last about 70 hours with the same amount of energy as used in this test. The cost of these carbons is $2 each, which approximates six cents per pound, or .18 cent per kilowatt hour. The cost of lime I have put at $5 per ton, and coke at $2.50 per ton, these figures being about the average prices for these materials of good quality, and considerably less than the actual cost of them at Spray. The question of the cost of electrical energy is the all important one, so that I have taken the Niagara price of $20 per electrical horse-power per year of 8,760 hours, considering this to be the lowest commercial price obtainable at the present time, and one which offers no question as to its accuracy, it being one which is absolutely tangible. The estimate is further based on the assumption that the carbide plant is to be operated at full load 24 hours per day and 365 days each year, so that the actual cost per electrical horse-power hour of energy consumed may not exceed $20 divided by 8,760, which is .238 cents, or .317 cents per kilowatt hour. With this data as a basis, the cost of producing one ton of calcium carbide at Niagara Falls, in a plant having ten 200-kilowatt furnaces producing 10 tons of carbide per day, would be as follows:

POWER.		
4,320 kilowatt hours at .317 cents per kilowatt hour		$13.69
MATERIALS.		
2,085 pounds of lime at $5.00 per ton		5.21
1,339 pounds of coke at $2.50 per ton		1.67
CARBONS.		
Carbons for 4,320 kilowatt hours at .18 cent per kilowatt hour		7.78
SUPERVISION AND LABOR.		
Operating two shifts 12 hours each:		
1 superintendent at $5	$5.00	
1 chemist at $4	4.00	
2 foremen at $2.50	5.00	
10 regulating men at $1	10.00	
6 furnace men at $1.50	9.00	
2 grinders at $1.50	3.00	
6 laborers, handling and grinding and mixing at $1.50	9.00	
	$45.00	
Labor per ton, $45÷10		4.50
Cost of barrels and preparing carbide for shipment		1.00
		$33.85
Interest at six per cent on $25,000, the investment necessary to erect the factory, furnaces, crushing and mixing machinery, apparatus for handling and regulating	$1,500	
Depreciation on $25,000, at 5 per cent.	1,250	
Taxes at $10 per 1,000	250	
Insurance at $3 per 1,000	75	.84
	$3,075	

Cost of production at Niagara	$34.69
Freight from Niagara to New York, Philadelphia, Boston or Chicago, at 15 cents per 100 pounds	3.00
	$37.69

This estimate of cost per ton of calcium carbide is intended to represent the cost of manufacture to a large gas company operating in New York, Boston, Philadelphia or Chicago, with its calcium carbide works at Niagara, and whose business would be to produce acetylene from the carbide in the city where the gas is to be used and to distribute it to its customers through its existing mains. It is not intended to represent the cost cleared off its books of any corporation or firm whose sole business would be the manufacture of calcium carbide for the market, for to cover that case we must add to the above estimate the cost of general expense, including administration, royalties and selling expenses, which of necessity would be equal to a large percentage of the factory cost as given. Let us then consider the value of acetylene to the gas companies in large cities. In many articles and circulars treating of this question it has been customary to place the actual cost of acetylene as produced from the carbide, taking the factory cost of the carbide as a basis, against the selling price of illuminating gas at $1 per 1,000 cubic feet. This, of course, is not a fair comparison and is very misleading. Believing that the only fair way to consider the relative value of acetylene and water gas is to compare them upon the basis of cost per candle-power hour in the holder, and assuming that the cost of distribution is the same in each case, I will treat the question on that basis.

We have seen from the results of the tests at Spray that for each pound of carbide we obtained 5.24 cubic feet of acetylene, or 10,500 cubic feet per ton; therefore, the cost per 1,000 cubic feet of acetylene would be one-tenth the cost of one ton of calcium carbide. The candle-power of acetylene being placed at 240 for each five cubic feet of gas, and the candle-power of water gas in the large cities at 25 for each five cubic feet of gas, it will be seen that the candle-power of acetylene is 10 times that of water gas per 1,000 cubic feet, and, therefore, the cost of acetylene giving the same candle-power as water gas would be equivalent to water gas at a cost per 1,000 cubic feet equal to one-one-hundredth of the cost per ton of calcium carbide. For example, if the calcium carbide costs the gas company $100 per ton, then the cost of acetylene gas in the holder will be equivalent to 25 candle-power, water gas costing $1 per 1,000 in the holder.

The present average cost of illuminating gas in the holders of the large gas companies approximates 30 cents per 1,000 cubic feet, while the cost of acetylene gas in the holder, with calcium carbide at $37.69 per ton, would be equivalent, light for light, to illuminating gas at $37\frac{7}{10}$ cents per 1,000 cubic feet, making the cost per candle-power hour of pure acetylene approximately 20 per cent higher than that of ordinary illuminating gas. If acetylene were mixed with air and distributed, the cost would be less. This has been done in an experimental way, using 60 per cent acetylene and 40 per cent air, but the advisability of attempting to distribute such a mixture through a system of mains in a city for commercial use is exceedingly questionable, owing to the risk of the mixing being improperly done and the quantity of acetylene falling to such a percentage as to form an explosive mixture.

It has been suggested that the cost of distribution, as well as the cost of mains and maintenance, which constitute a large portion of cost in the lighting industry, might be saved by the use of liquid acetylene, put up in cylinders and delivered to the stores, residences and offices, so that the consumer might generate his own gas as required. It appears to the writer that this method is an entirely impracticable and uncommercial one, as there are almost insurmountable objections to be overcome. Neither the average business man nor the occupants of a residence wish to be bothered with the care necessarily attendant upon the use of the cylinders of acetylene. It would be necessary either to have two cylinders ready for service or to have a second one placed in service before the first one was exhausted, and in all probability the busy man would find himself in darkness at the time when he most needed the light, owing to the fact that he had neglected to renew his cylinder. The pressure of the gas in these cylinders is from 600 to 700 pounds, so that it is necessary to use a reducing valve which will give a pressure of one ounce. The same valve which is used with the Pintsch system of railway lighting is employed, but this, in all probability, would not be kept in condition by the ordinary householder or storekeeper, and the consequence would be that the full pressure might be impressed upon the pipes, and in case this were prevented by the use of an auxiliary safety valve, then every failure of the reducing valve would allow all the gas to escape and be lost. The use of acetylene cylinders would increase the danger in case of fire, since the gas would escape should the cylinders become heated, and explosions of the mixture of acetylene gas and air would possibly follow. After considering the many inconveniences and dangers in the use of liquid acetylene in the business and residence district of the large cities, it leads the writer to believe that acetylene, to be commercially successful, must be delivered to the customers in the form of gas through a system of mains, as is done now with ordinary illuminating gas. Liquid acetylene should find a field in the lighting of country estates, railway trains, and for use in carriage, bicycle and locomotive head lamps, and in isolated places where distribution by mains is not possible.

When acetylene was first brought forward to be used commercially, it was expected that the gas companies might still maintain their existing gasworks and use acetylene to enrich their gas and furnish a 25-candle-power flame as formerly, but at a much less cost. Experiments have shown, however, that, although coal gas may be enriched by acetylene, water gas is not susceptible to enrichment by it. Water gas, which is furnished in nearly all the large cities, has little illuminating power of its own, is now treated with petroleum, and it is only when enriched to a certain candle-power that acetylene may be mixed with it without losing its candle-power, so that we can not, as at first supposed, substitute acetylene for petroleum and use it economically as an enricher of low candle-power water gas.

It has been suggested that the manufacture of calcium carbide might be carried on by the central station electric lighting companies as a by product, furnishing the energy necessary for its production during the hours of light load upon the lighting system, thus bringing the load curve of the station nearer to a straight line and thereby improving the economy of the station operation. It will be readily seen from the figures given in the estimate of the cost of producing the carbide that the cost of power is a very important factor, and if we increase the cost given, of $20 per horse-power per year, we will correspondingly increase the cost of the carbide. From experience with the cost of operation of the largest central lighting stations in this country, the writer can safely state that the absolute cost of fuel alone in the most economically operated lighting station of the most modern type of multiple expansion condensing plant averages .3 of one per cent per kilowatt hour, or approximately $20 per horse-power per year continuous service, while the total cost of generation in the station would average over double that amount. In the average of the large central stations the generating cost at the switchboard, without distribution and general expenses, approximates one cent per kilowatt hour, which is about $65 per horse-power per year, and in the smaller stations using steam, double that amount. It is obvious then that we may not hope to use our present central stations during minimum hours for the manufacture of calcium carbide as a by-product while the cost of power in our stations remains as it is at present, and the amount of power required for the production of carbide so excessive as the cost of its production by the central station would be prohibitive. It would be much better and more economical for the central station manager to sell his electrical energy through the incandescent or arc lamp at the same price per kilowatt hour than to use the energy for the production of carbide, since the cost per candle-power hour would be less when the electrical energy is converted into light directly through the incandescent and arc lamps than through calcium carbide and pure acetylene, assuming the cost of distribution and general expense to be the same in each case. Take, for example, carbide at $40 per ton, which means 40 cents cost per 5,000 candle-power hours of acetylene gas in the holder, or 125 candle-power hours for one cent. Compare with this electrical energy at the switchboard at two cents per kilowatt hour. For each kilowatt hour generated we obtain twenty 50-watt incandescent lamps, each giving 16 candle-power, making a total of 320 candle-power hours per kilowatt hour, or 160 candle-power hours for one cent, which is 28 per cent more candle-power for the same expenditure of money by the use of the incandescent lamp directly as a converter of electrical energy into light, as against the conversion by means of carbide of calcium and acetylene.

If we take the case of the arc lamp and add to the cost of the electrical energy 1.5 cent per kilowatt hour for carbons, trimming and lamp repairs, making the total cost 3 5 cents per kilowatt hour, we find it still more advantageous. Assuming a 500-watt arc lamp gives 1,000 candle-power, we have 2,000 candle-power hours per kilowatt hour, or 575 candle-power hours for one cent, which is 4.6 times the illumination for the same money as compared with pure acetylene gas. Taking the cost per kilowatt hour at the switchboard in the large central stations, we obtain 320 candle-power hours for one cent, which is 156 per cent more candle-power for the same expenditure of money by the use of the incandescent lamp directly as a converter of electrical energy into light, as against the conversion by means of carbide of calcium and acetylene. By means of the arc lamp, on the basis of cost of one cent per kilowatt hour for electrical energy and 1.5 cent per kilowatt hour for carbons, trimming and lamp repairs, we obtain 800 candle-power for one cent, or 6.4 times the illumination for

the same money as compared with pure acetylene gas.

From these deductions and considerations, gentlemen, it may be concluded, in the light of our present knowledge, and upon the basis of the estimated cost of production of the calcium carbide, that acetylene gas should not drive the incandescent and arc lamp from the lighting field, neither should it make such inroads on the electric lighting business as to materially affect the earnings of existing central station companies, for after all acetylene is a gas and burns with a naked flame, and the use of incandescent and arc lamps has steadily increased year by year, not because of their cheapness, but because of their infinite superiority as illuminants over any gas flame yet developed.

PERSONAL.

Mr. Henry C. Seaman, civil and consulting engineer, has opened an office at 40 Wall street, New York.

Mr. R. H. Read, a well known electrical patent lawyer of New York city, has removed his offices from 39 Cortlandt street to 44 Broad street.

Mr. W. Worth Bean, of St. Joseph, Mich., writes an interesting article to the *Evening Press*, of his city, giving facts and figures against municipal ownership of electric light plants.

Mr. W. J. Morrison is now general agent for the Ball Electric Light Company, of New York city. He expects to devote his time and talents to advancing the interests of this company.

Among the visitors to the ELECTRICAL REVIEW office the last week were Mr. F. M. Laughlin, treasurer of the Solar Carbon Manufacturing Company, Pittsburgh; Mr. W. Forman Collins, of the *Western Electrician*, Chicago; Mr. R. C. Jackson, of the Railway Mail Service, New York; Mr. Adolph Müller, of the Tudor Storage Battery Company, of Germany; Prof. John P. Barrett and S. F. B. Morse, of Chicago; W. R. Brixey and Timothy W. Sprague, of New York.

The New Offices of the Standard Paint Company.

As before announced in these columns, the Standard Paint Company has been compelled to take much larger and more commodious rooms at 81–83 John street, New York. The energetic staff of the company is now located in very comfortable quarters. President Ralph L. Shainwald occupies the very pleasantly arranged and furnished second floor, front, and various other departments with their chiefs are located on the same floor. Mr. Frank S. De Ronde, the general sales agent of the company, whose energy and enterprise has done so much to insure the solid success of the company, is located on the first floor adjoining the business offices. Large warerooms and excellent facilities for handling and shipping goods complete the very excellent arrangements for handling the large business of this company. The ELECTRICAL REVIEW congratulates the Standard Paint Company on its splendid business and successful management.

THE EVOLUTION OF THE ARC LAMP.

(Concluded from page 261.)

or slipping by, whether the lamp be shunt or differential.

I quote from a recent article by Alex. Dow, of Detroit: "In the plant I operate, analysis of the 'outs' for two months showed that lapping was responsible for too much of the total trouble. We were running with $\frac{7}{16}$-inch carbons in both holders. We changed to $\frac{5}{8}$-inch uppers, retaining the $\frac{7}{16}$-inch lowers. Result for four Winter months' operation of 1,480 street arcs is just one 'out' by lapping." Mr. Dow is ahead of the lamp he tried to fix. He neglected to state that he was compelled to break his $\frac{5}{8}$-inch carbons off so that the weight would be no more than a $\frac{7}{16}$x12. This lamp was not designed on evoluted ideas. A heavier weight in the upper carbon-holder would position the armature in a different plane as regards the operating magnet.

The double-carbon lamp has outlived its usefulness. It filled a gap for a few years. Its only recommendation is that it will burn all night long. Its drawbacks are numerous. More mechanism is required—two carbon rods with two sliding contacts. The arc is struck well up near the top of the globe at one side—not in the center—and travels downwards. This causes an uneven heating of the glass, which results in globe breakage, especially in severe climates. I have known a number of superintendents who always took the precaution to crack their globes with a soldering-iron before putting on; then, by putting on a net, the unequal expansion and contraction were overcome.

The globe question is a troublesome one at best. The globe should be fastened on without screws; trimming should be done without touching or lowering the globe and the globe should be cleaned without removal. If this can be done (and it can be), a bill from the globe manufacturer should be a matter for investigation.

Never losing sight of the fact that the function of an arc lamp is to diffuse light as much as possible and in every direction possible, any unnecessary opaque substance which is interposed between the arc and the surrounding space to be illuminated shows a defect which is simply monstrous. With one pair of carbons burning 16 hours we need have only one single arm of small cross-section, reaching down to sustain the globe-holder. The shadow from this arm can be thrown directly against the pole or building, leaving absolutely unobstructed light for the street. We can arrange the trimming to be done quickly and without touching the globe. The globe can be cleaned without removing.

It is a very noticeable fact that those who have had the most intimate acquaintance with arc lamps, and have operated practically the largest lighting stations for the longest time, are the men who are the most eager to hear of a lamp constructed on new principles.

The West Side Park, Chicago, is about purchasing a large arc lighting plant—one of the largest ever installed at one time. They want 750 arc lamps. The specifications drawn by their engineer, Mr. Foree Bain, reached me a few days since. They are sufficiently unique to be preserved. His idea, I think, is new. He asks a number of questions. The bidder is to answer these questions on blanks furnished, said answers to form the guarantees of the bidders.

These specifications read as follows:

Single or double carbon?

Size of carbons? Upper ..... Lower.....

Cross-section?

Market price of such carbons per 1,000?

Length of time the lamp will burn with one trimming, in circuit of 9.6 to 10 amperes, and a difference of potential of 45 to 50 volts at terminals of lamps?

With 6½ amperes and 45 volts?

Will the lamp burn at a practically constant voltage of 45 to 50 volts while the current may be changed from 9.6 amperes to 6½ amperes?

If not, what range do you guarantee?

In stating guarantees above, do you refer to the use of plain or plated carbons?

State make of carbons referred to.

If such carbons are covered by patents, making them a monopoly, state price per 1,000 you hereby guarantee they will not exceed for a period of five years from date hereof.

By what means are the carbons adjusted to a coaxial position?

By what means are they maintained in a position coaxial with regard to each other?

What is the extreme length of lamp?

What is the weight of lamp with globe, trimmed and hung ready for operation, with hood and hanger board, if such be necessary?

How many side rods for supporting the globes and negative carbons?

Diameter of each intercepting the rays from the arc?

Length?

Is it necessary to remove or disturb the globe when trimming the lamp?

Does your lamp require a special globe?

If so, at what price do you guarantee they will not exceed for a term of five years from date?

Of what material is the jacket or case composed?

How removed for inspecting the operating mechanism?

Is the lamp shunt or differential?

After the arc is struck, is the series coil retained in circuit?

Is its responsive mechanism in continuous active motion?

What is the electrical resistance of the series coil and its connections?

What is the resistance of the shunt coil?

Of what size wire is it composed in decimals of an inch?

How many active pivotal joints in operative mechanism?

How many springs in the lamp?

How many variable adjusting devices are there in the lamp?

Are they sliding or pressure?

Of what metal composed?

Maximum current carried?

Can they be readily replaced?

Will the automatic cut-out re-establish the arc when the carbons come together?

Within the limit of what number of volts can the cut-out be adjusted to positively operate?

If a double lamp, what is the difference of voltage between two pairs of carbons when in normal operation?

Is any resistance cut into the main circuit when the lamp automatically cuts out?

How many ohms?

What is the form of cross-section of the carbon-feeding rod?

How is the circuit completed through the rod?

What is the area of surface contact of the clutch with the rod in decimal of square inch?

What is the voltage and current at which the lamp is best adapted to operate?

State the maximum and minimum voltage between which the lamp will operate and feed in practical service, during a period of six months.

Mention any special features of your lamp.

The man who could ask those questions is hunting for an arc lamp different from the ordinary. They show that he has fought and bled with a multiplicity of spools, springs, rods, sliding contacts, lapping carbons, broken globes and rusty sheet-iron cases, and that he has lived within the dark shadows thrown by the old-style lamps, and gazed for years upon landscapes marred by the contours of the arc lamps of the period of 1875 to 1895.

TELEPHONE NEWS AND COMMENT.

Erie Telegraph and Telephone Company made a net gain of 3.2 subscribers in April, making the gain for the first four months of the fiscal year 1,005. Total number connected May 1, 19,596.

The annual meeting for the election of directors was held last week by the stockholders of the International Bell Telephone Company (Limited) at 32 Liberty street, New York. The following were elected: Samuel D. Babcock, Gardiner G. Hubbard, Louis A. Von Hoffmann, Richard A. McCurdy, Charlton T. Lewis, Elisha S. Converse, William Mertens, Howard S. Randall and Louis A. Thebaud. The company's business is all done abroad.

The Western Telephone Construction Company, of Chicago, during the past week closed what is claimed to be the largest single contract for a telephone exchange equipment ever made. The contract covers nearly 7,000 telephones and switchboard equipment to match. This equipment is for a large American city, the location being still kept secret. It is asserted that this system will demonstrate a central office system of great superiority. It is the invention of Mr. J. E. Keelyn, president of the company, and only requires the number of drops and jacks to correspond with the number of subscribers' lines.

The Telephone Construction Company, 35–37 Frankfort street, New York city, is a comparatively young company, which has entered the field with the view of doing telephone construction work to the exclusion of telephone manufacturing. Since the company has been in existence it has installed quite a number of telephone plants, and some of the plants recently completed are those in the Hoffman House, New York, the drygoods house of Koch & Company, Sullivan, Drew & Company, and installations in the Fleischman's yeast establishment and the manufacturing building of J. W. Goddard & Company. This company states that it has special patents for interior wiring now pending.

KIND WORDS.

A VALUABLE JOURNAL.

TO THE EDITOR OF ELECTRICAL REVIEW:

I am no practical electrician, but I read your journal regularly. I find it very valuable in keeping me posted on things electrical and what is new in the electrical world. I experiment occasionally. I think your journal is as important in my library as any published. Hoping you will always have lots of subscribers, etc., I am,

Yours respectfully,

E. D. SHEINER.

May 13.

The Mechanical Stoker Exhibited at the Exposition.

Of the many exhibits for the boiler roomer, perhaps none attract more attention at the Exposition building, in New York, than the American underfeed mechanical stoker, which is being shown by Mr. Chas. G. Stoddard, vice-president and treasurer of the American Stoker Company, of Dayton, Ohio. During the past few years a number of types of stokers

FIG. 1.—AMERICAN STOKER APPLIED TO TUBULAR BOILER.

have been on the market, but it has remained for this company to perfect and simplify the machine for practical use.

The illustration No. 1, from a photograph, shows a front view of an installation of tubular boilers equipped with the stoker.

The fuel is carried by the conveyer or "worm" into the stoker bed and is then evenly distributed by the action of the tapered conveyer, depositing an equal amount of fuel at the ends. The worm is driven by a ratchet-wheel and prawl, which are in turn driven by the mechanism extending in front of the boilers. The feeding of the coal being continuous, the fire is in a state of constant agitation, allowing the free mixture of air and rendering large clinkers impossible.

The non-combustible in the fuel is gradually pushed to the side of the furnace and is taken out in small vitrified clinkers, leaving no ashes. It is claimed that the absence of smoke and ashes is indicative of perfect combustion.

The illustration, No. 2, is a rear-end view of the tubular boiler and No. 3 is from a sectional drawing, showing the lateral construction and operation.

An Enlarged Plant for a Telephone Manufacturing Company.

The Phœnix Interior Telephone Company has removed from the old quarters, at 131 Liberty street, New York, and has established commodious salesrooms and offices at 157 Greenwich street, near Liberty street, and a large manufacturing plant at 108 Greenwich street. This company has rapidly become one of the most substantial of the independent companies manufacturing telephones, and this material enlargement of facilities is an indication of their progress.

A Chance to Get Good Machine Tools Cheap.

The Garvin Machine Company, of New York, expect to occupy their new factory and salesrooms, at the corner of Spring and Varick streets, this city, about June 1. They tell us that they will equip their new plant throughout with new and improved machinery of best makes, and that they now have for sale a very large stock of good second-hand tools, which they desire to sell at very reasonable prices before removal.

They have issued a list of these tools, which they designate List No. 17 E, showing engine lathes, planers, shapers, drill presses, milling machines, screw machines, gear cutters, presses, shears, grinding and polishing machines and many other miscellaneous tools. This is an opportunity for all who need such tools. List 17 E will be sent free to all applicants.

A Faithful Servant.

Mr. George Warren, who was for 34 years in charge of the telegraph department attached to Queen Victoria's household, died recently in England.

Double-Crank Cutting Press for Large Armature Disks.

The accompanying cut shows a press especially adapted for cutting out large armature disks, which has been introduced by the Ferracute Machine Company, of Bridgeton, N. J. They make a great variety of presses in all sizes, from 34 inches up to 100 inches between columns, and with both square, oblong and round beds, and they are built from both heavy and light patterns, and with and without gearing, as required for various kinds of work. There are about 120 sizes of these presses all told, and they are all carefully and accurately fitted up with an improved form of automatic steel clutch, new form of adjustment for the ram, treadle lock, safety lock, self-oiling device for flywheels, etc.

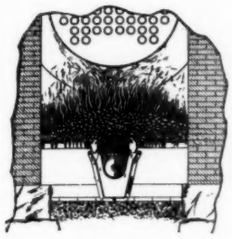
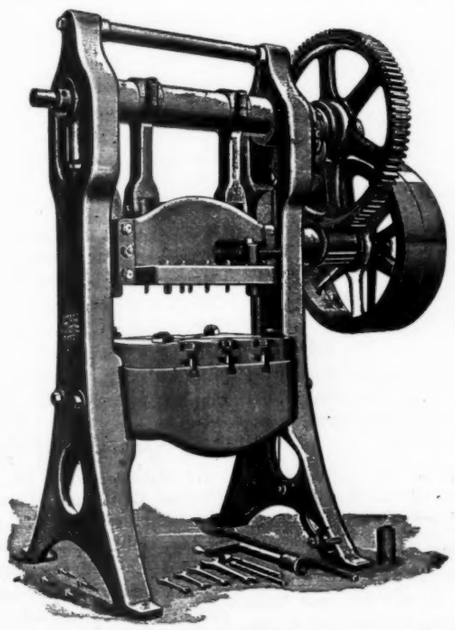


FIG. 2.—END VIEW OF STOKER IN POSITION.

The dies generally used in these presses are arranged so they will cut the armature disk blank in plain circular form, with center hole and notch, and the teeth in the disk are afterwards cut in a special indexing machine, which is adjustable for various numbers and sizes of teeth, and for all sizes of disks from three inches to 36 inches in diameter.



DOUBLE-CRANK CUTTING PRESS FOR LARGE ARMATURE DISKS.

The Ferracute company have an exhibit of their presses at space G 152, north side, at the New York Electrical Exposition, and show their indexing and also their cutting and punching machines running with motors and with dies set in presses. They make a specialty of presses and dies for electrical work, and have furnished outfits to many of our largest manufacturers. The press shown is known as SG 31, the weight of it being 6,300 pounds; distance between columns, 34 inches; hole in bed, 16x24 inches; size of flywheel, 40 inches; weight of wheel, 1,100 pounds. Further information about this press and various other presses will be found in the handsome catalogue issued by the Ferracute company.

ELECTRIC LIGHT FLASHES.

The office of the Municipal Electric Light Company, of Brooklyn,

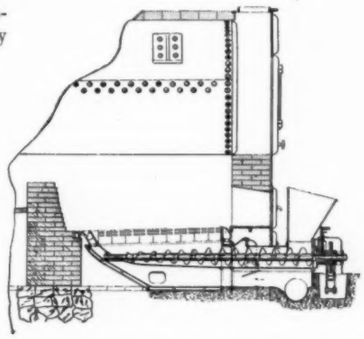


FIG. 3.—SIDE ELEVATION OF AMERICAN STOKER AND TUBULAR BOILER.

N. Y., has been removed from 126 Broadway to 208 Broadway.

The war in Cuba has made such hard times in Havana that nearly every one is too poor to pay gas or electric light bills. Shares of the Havana Consolidated Gas and Electric Light Company have sold for six cents on the dollar.

The earnings for April of the Edison Electric Illuminating Company of New York, inclusive of the high tension systems, were as follows:

	1896	1895	Increase.
Gross,	$180,110.64	$163,410.74	$16,699.90
Net,	90,584 30	77,685.75	12,898.55
Gross, 4 months,	777,670.05	712,452.28	65,217.77
Net, 4 months,	399,368.68	342,582 25	56,786.43

A company has been organized in Chicago, with a capital stock of $100,000, to exhibit in all the important cities of the country, Canada, Mexico and Europe the workings of X rays. Negotiations are now under way to open exhibitions in New York, Boston, New Orleans, San Francisco and intermediate cities.

The contract which the Electric Storage Battery Company, of Philadelphia, has made with the Hartford, Ct., Electric Light Company, provides for one of the largest individual installations in the country. The battery will have a capacity of about 2,500 horse-power hours. It will operate on the three-wire Edison system and will be charged from a station 11 miles distant. The work is expected to be completed before Autumn.

Electric Locomotives.

The third electric locomotive for the Baltimore & Ohio belt line tunnel arrived in Baltimore last week. Master Mechanic Hill, of the Pennsylvania Railroad, is quoted as saying that inside of five years the greater part of the entire Pennsylvania Railroad system will be operated by electric locomotives.

ADVANCE INFORMATION

Valuable News and Tips for Manufacturers and Dealers.

We publish below information relating to new electric railways, new electric light companies, new telephone companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW.

Electric Light and Power.

CHESTER, PA.—The Beacon Electric Light Company has signed a contract for lighting this city for the next five years, and will build a plant.

EUFAULA, ALA.—H. W. Veazy & Son have secured the contract to build the electric light plant.

ELKHART LAKE, WIS.—The Plymouth Water, Light and Power Company has asked for franchise to set up and maintain poles, wires, etc., for furnishing electric light, heat and power for this village.

LANCASTER, MASS.—It is said that a new electric light company will be organized and a light placed on Mount Washington the coming Summer; the electricity to come from the big plant at Niagara Falls.

ABBEVILLE, S. C.—Wyatt Aiken may be addressed for information concerning construction of an electric light plant.

BERKLEY, VA.—The Berkley Electric Light and Power Company will add new machinery to its plant.

BLANCHESTER, OHIO—Owen Brown, clerk, can give information concerning construction of electric light plant, for which $30,000 in bonds will be issued.

WHITEHALL, MICH. — A $5,000 electric light plant will probably be established.

IRVINGTON, IND.—C. B. Clark, clerk, can give information concerning erection of municipal electric light plant.

LOWELL, MASS.—Work of erecting the municipal lighting plant has been commenced, and will be rapidly pushed to completion.

LEWISTOWN, PA.—Lewistown Gas Light, Heat and Power Company has been incorporated by S. B. Weber. Capital stock, $22,000.

THREE OAKES, MICH.—Steps are being taken to establish an electric light plant.

WASHINGTON, D. C.—The Potomac Electric and Power Company has been granted permission to extend its lines, and to operate them for light, heat and power purposes.

OLIVIA, MINN.—An electric light plant will probably be constructed.

MILLVILLE, MASS.—An incandescent light plant is being installed in the new fire station.

New Electric Railways.

JERSEY CITY, N. J.—It is said that there is a plan to build a new trolley line which would eventually connect Newark and Paterson by a direct road.

ELYRIA, OHIO—The Lorain County commissioners have granted T. Y. McCray, Nelson Ozier, B. F. Platt and T. R. Martin a franchise to build an electric road from the Ashland County line to Wellington, Ohio.

CHICAGO, ILL.—The West Taylor street cars will be operated by electric power in a few days.

NILES, MICH.—An electric railroad will be built soon from South Bend to Benton Harbor, running through Niles, Buchanan and Berrien Springs.

BOSTON, MASS.—The street railway committee reported a bill to incorporate Samuel L. Minot and others as the Barnstable County Street Railway Company. The capital is $100,000.

TAUNTON, MASS.—The Taunton & Brockton Street Railway Company has been incorporated. Capital, $100,000, with authority to issue $100,000 bonds.

SOUTHBRIDGE, MASS.—The contract for building the Southbridge & Sturbridge street railway has been awarded to the Worcester Construction Company. The contract for constructing the car house has been awarded to O. J. Aldrich, of Southbridge.

FALL RIVER, MASS.—A railroad is being built from Braley's station, on the New Bedford road, to Quittacus pond in Lakeville for the benefit of the New Bedford waterworks. The cars will be run by electricity and will be used entirely for freight. A new and large reservoir is to be built in the northwestern portion of the city for an additional water supply.

CORRY, PA.—An electric street railway system is to be established here.

GREENBUSH, N. Y.—Local capitalists are canvassing the project of building an electric railway from this place to Kinderhook.

NORRISTOWN, PA.—The Schuylkill Valley Traction Company has awarded to W. A. Cullen, of Paterson, N. J., the contract for constructing an extension of its line.

BOSTON, MASS.—An extension of the New England line from Allyn's Point to New London is contemplated.

WEST SPRINGFIELD, MASS.—The Suffield, Agawam & West Springfield Railway; I. L. Currier has been elected president and director of the new electric railway, of which the capital stock is $150,000.

JACKSONVILLE, FLA. — The St. Augustine & Jacksonville Electric Railway will be constructed by way of Mandarin and Florence. It will be operated by the storage battery system.

SUTTON, MASS.—The Millbury, Sutton & Douglas road; citizens will probably take $25,000 worth of stock in the new electric railway.

New Telephone and Telegraph Companies.

SYRACUSE, N. Y.—The Home Telephone Company has been organized; capital, $200,000. Directors: R. S. Law, of New York; John Gibney and Edgar L. Ryder, of Sing Sing, and L. E. Wilmarth, E. A. Andrews, John Filmer and Robert Baker, of Brooklyn.

SAN FRANCISCO, CAL.—California Exploration Company has been incorporated by A. Poniatowski, Paris, France; J. W. Sperry, Sansalito, Cal.; Chas. E. Green, San Francisco, Cal., to construct telegraph and telephone lines. Capital stock, $2,000,000.

HARBOR SPRINGS, MICH.—There is a project on foot to connect Beaver Island with the main land by a telephone line.

DENVER, COLO. — The Colorado Telephone Company has secured a site on Third street, just above Bennet, and will commence the construction of a temporary building, and will follow at once with a permanent fire-proof structure.

PRESTON, MINN.—This city is to have still another telephone line. Chase Brothers are the promoters, and general offices will be established here.

MILWAUKEE, WIS.—The long-distance telephone line which now ends at Menominee, Mich., is to be extended to Escanaba, Iron Mountain, Negaunee, Ishpeming and Marquette.

AMSTERDAM, N. Y.—The Amsterdam Automatic Telephone Company has been incorporated to connect towns in Montgomery County by telephone from this place. The capital is $15,000 and the directors are Willis Wendell and John K. Stewart, of Amsterdam; George F. Purdy, of Brooklyn, and others.

NEWARK, N. Y.—The franchise recently granted R. F. Randell to put in a local telephone exchange has been purchased by W. H. Kelley.

BEAVER, PA.—Beaver & Burgettstown Telephone Company has been incorporated by Frank Springer. Capital stock $2,000.

PRINCETON, MO.—The Princeton Telephone Company has been incorporated by Ira B. Hyde and others. Capital Stock $1,000.

New Manufacturing Companies.

ROCKLAND, ME.—The Fairbanks Electric Bell Buoy Company has been organized for the purpose of buying, selling, holding, owning and leasing, on royalties or otherwise, and manufacturing the invention known as Fairbanks electric bell buoy and all improvements thereon, with a capital stock of $500,000. The officers of the company are: President, C. E. Littlefield, Rockland, Me.; treasurer, Charles S. Dennis.

NEW YORK, N. Y.—The Silica Hydro-Carbon Company has been organized to manufacture material, apparatus and appliances used for electrical conduits. Capital stock, $100,000. Directors, William A. Cashen, Isidora J. Pocher and William M. Croues, of New York city.

NEW YORK, N. Y.—The Insulator Company has been organized to manufacture insulators for electric railway, light, telephone and telegraph; capital, $25,000. Directors, H. S. Newton and W. B. Smith, of Syracuse, and Albert Vickers, of New York city.

PHILADELPHIA, PA.—James Smith & Company has been incorporated by Thos. Cunningham, Lucien Brown, Horatio B. Lincoln, to manufacture textile machinery and electrical appliances. Capital stock, $100,000.

AVON, N. Y.—Avon Electric Company has been incorporated by Cyrus Allen, Alva Carpenter, Charles F. Whiting, E. H. Babcock, James D. Carson, E. A. Nash. Capital stock, $12,000.

LANSINGBURG, N. Y.—The Beacon Electric Company has been incorporated to manufacture electricity for light, heat and power; capital, $100,000. Directors, William M. Lea, Samuel Bolton, Jr., and Edward Van Schoonhoven, of Lansingburg; E. B. Ellicott and J. W. Ebert, of Chicago, and Albert Will and J. G. Kaelber, of Rochester.

CLEVELAND, OHIO—The Nungesser Electric Battery Company has been incorporated; capital stock, $10,000.

HASTINGS, N. Y.—The National Underground Cable Company has been incorporated to manufacture and construct wires, cables and electrical conductors and all kinds of electrical, railway and subway equipment; capital, $200,000. Directors: George J. Jackson, of Brooklyn; Cornelius Gallagher, of New York; Edward S. Perot and William H. Lewis, of Yonkers, and James P. McQuaide, of Nyack.

Increase of Capital.

COHOES, N. Y.—The Cohoes City Railroad has increased the capital stock of the company from $50,000 to $70,000.

FALL RIVER, MASS.—The W. S. Hill Electric Company has increased the capital stock $10,000, making it $70,000. Frank S. Stevens, of Swansea, was added to the Board of Directors.

WADSWORTH, OHIO — Wadsworth Electric Railway Company is changed to Cleveland, Wadsworth & Southern, and stockholders authorized increase of capital stock to $600,000.

JACKSONVILLE, ILL. — The Los Angeles Traction Company has increased its capital stock from $100,000 to $250,000.

ST. LOUIS, MO.—The International Electric Company has filed articles to increase its capital stock from $15,000 to $20,000.

Miscellaneous.

CAMDEN, N. J. — United States Conduit Company has been incorporated by Wm. S. Miller, Solomon S. Miller, Jacob E. Ridgway, Philadelphia, Pa., to construct conduits for electric wires, etc. Capital stock, $25,000.

Special Electric Light Convention Supplement

ELECTRICAL REVIEW

NEW YORK, MAY 20, 1896.

SOME ACCOUNT OF THE EVOLUTION OF THE INDUCTOR ALTERNATOR.

(*Continued from page 8, Supplement, May 13, 1896.*)

has become a matter of course. Yet, in respect to the steadiness of the flux, this machine is distinctly retrogressive and decidedly inferior to Wheatstone's second design. Holmes intended the machine for electric lighting, but I am not aware of its ever having come into practical use.

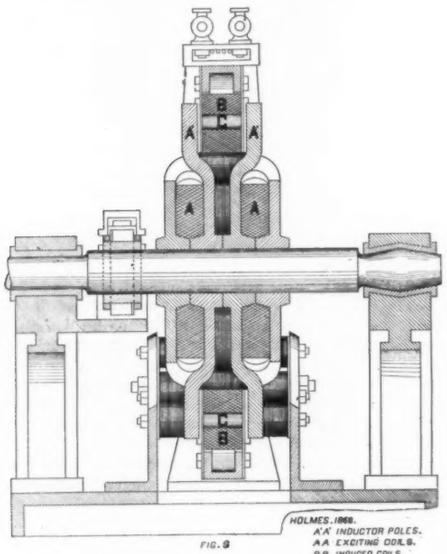


FIG. 9

HOLMES. 1868.
A'A' INDUCTOR POLES.
AA EXCITING COILS.
BB INDUCED COILS.
CC KEEPERS.

Gramme's invention came near putting an end to work on inductors, as, indeed, to work on alternators of any kind. Yet, in the time intervening between the introduction of the Gramme machine and the resurgescence of the alternator, provoked by the introduction of the modern transformer, C. F. Varley* designed an inductor, Figures 12 and 13, which deserves mention for its novelty. The induced coils are subject to the influence of two inducing magnets which tend to develop opposite fluxes through them. These

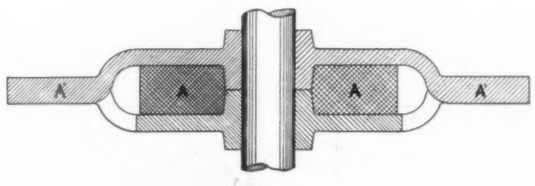


FIG. 10

HOLMES. 1868
A'A' INDUCTOR POLES.
AA. EXCITING COIL.

magnets are alternately short-circuited by the keepers, and, in consequence, the flux through the induced coils is alternated by arranging the keepers so that they begin to short-circuit one inducing magnet before entirely open-circuiting the other; the flux in the inducing magnets is kept more or less

* The figures of C. F. Varley's machine were made entirely from description. They may be quite different from those in his patent.

constant. In this same year, Paul Jablochkoff took out an English patent for an inductor alternator. It is of the single induced-coil type; but were it not for the inventor's great fame, considering the date, it would not be worth attention.

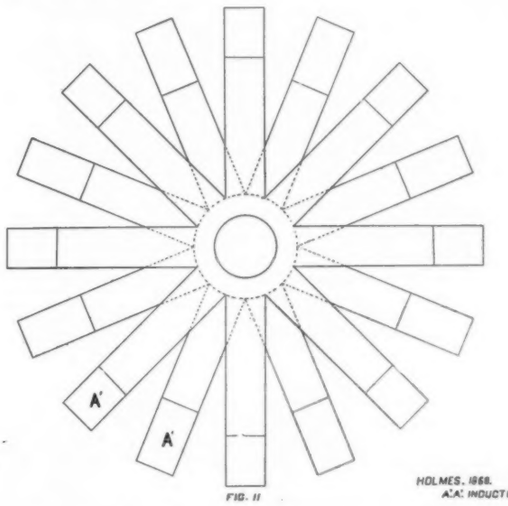


FIG. 11

HOLMES. 1868.
A'A' INDUCTOR POLES.

Even the best of these early inductors must have had vast iron losses. In most cases there was no thought of preventing them, and, when preventive

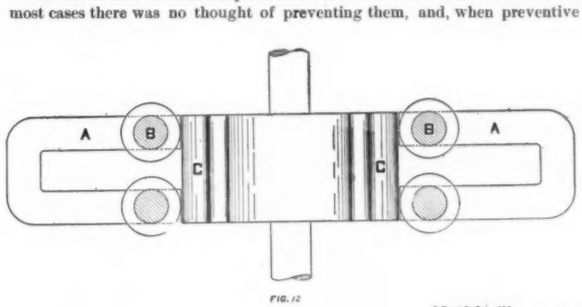


FIG. 12

C.F. VARLEY, 1877.
A.A. INDUCING MAGNETS.
B.B. INDUCED COILS.
C.C. KEEPERS.

measures were adopted, they were entirely inadequate. The mass of iron subject to magnetic change was always, relatively to the size of the machine,

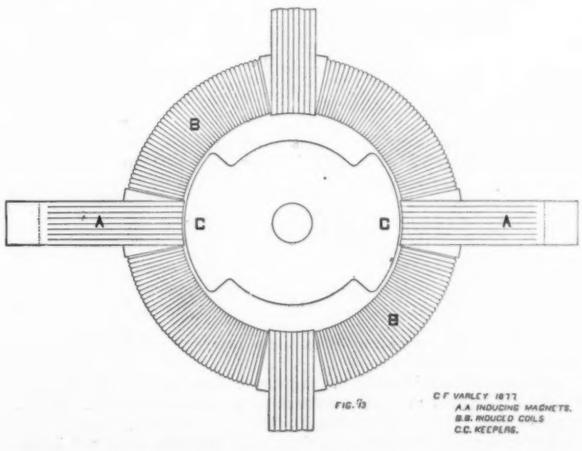


FIG. 13

C.F. VARLEY 1877
A.A. INDUCING MAGNETS.
B.B. INDUCED COILS
C.C. KEEPERS.

enormous, thus necessarily increasing the hysteresis loss; while no sufficient provision appears to have been made for the prevention of Foucault currents. The machine of Klimenko, exhibited at Vienna, which required more power

to drive it when running light than when loaded, was not, I think, exceptional.

In 1887, Mordey cut the Gordian knot by entirely suppressing the iron in the induced portion of the machine. The highly and deservedly successful machine that bears his name is shown in Figures 15 and 16.

There is a central core surrounded by the exciting coil A. From each end of this core projects a set of radial polar arms, which are recurved so as almost to meet one another. In the space left free are mounted the thin pieces C′, as well as the bridges C, tends to make the flux constant in amount and to restrict the magnetic changes to the induced portions of the machine. The iron subject to magnetic change is also properly laminated to prevent Foucault currents. The most obvious fault in the designs is that the mass of iron in the induced portions is large, and that all of it is subject to hysteresis loss.

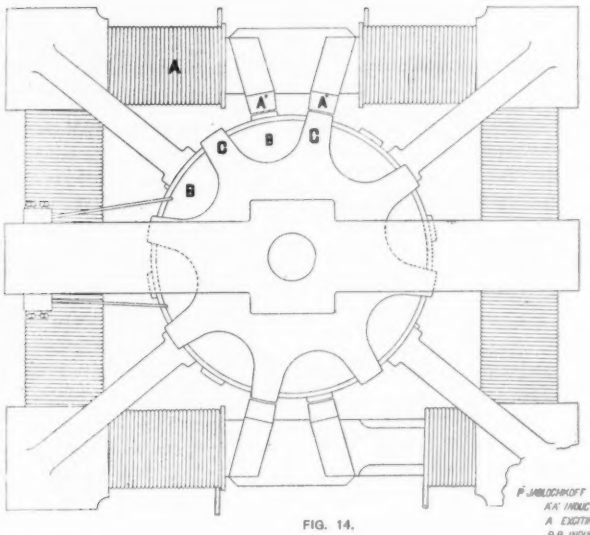


FIG. 14.

P. JABLOCHKOFF 1877.
A A′ INDUCTOR POLES.
A EXCITING COILS.
B B INDUCED COIL.
C C KEEPER.

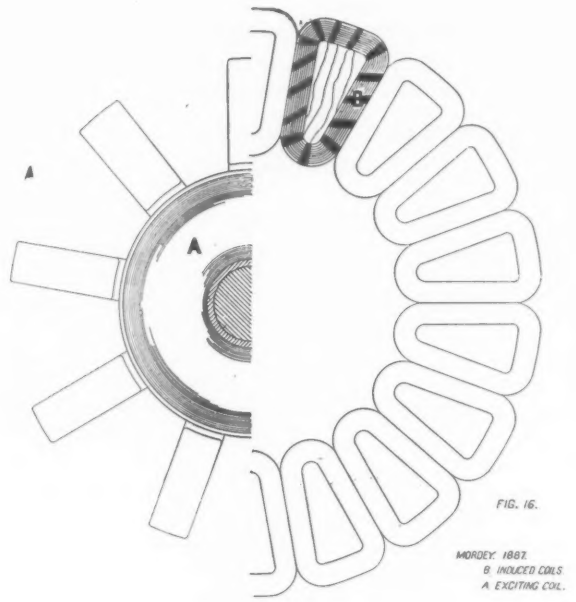


FIG. 16.

MORDEY. 1887.
B. INDUCED COILS.
A. EXCITING COIL.

induced coils BB in a circle. The induced coils are wound in the plane of this circle, and are in number twice the polar faces on one side. The induced coils are fixed and the inducing magnet revolves. The exciting coil turns with the core, but this is electrically immaterial, and the results would be the same were it at rest. Obviously, the total reluctance of the magnetic circuit is the same, no matter what the position of the inductor. Change of flux in the iron is due only to armature reaction, and it gives rise to iron losses only

In passing, it may be worth while to note one peculiarity of single induced coil machines like the earlier of the Mordey designs. With any given frequency, the output is independent of the speed; or, in other words, the only limit to reduction of speed is the possibility of further sub-dividing the poles. For, with the number of poles increased N times, the total change of flux takes place with 1/Nth the angular motion. This remarkable property may some day bring about the introduction of machines of this class for direct connection to very slow-speed engines.

The Kingdon machine, Figure 21, is a modernized Henley machine. The exciting and induced coils are wound on the alternate polar projections, and

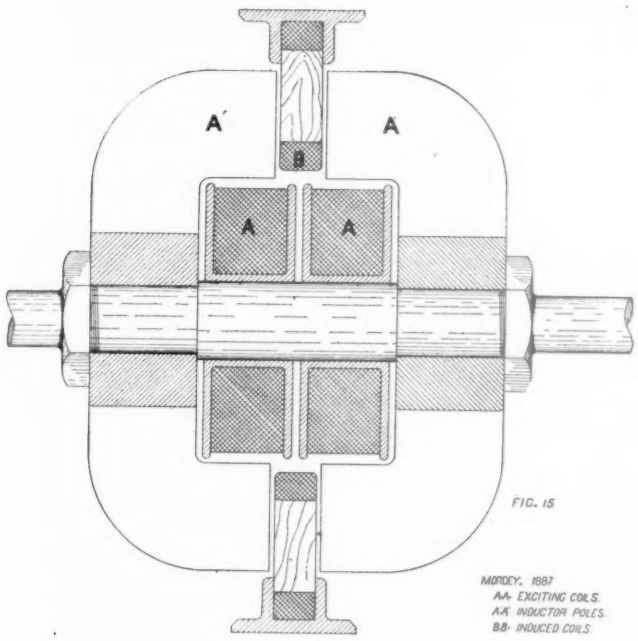


FIG. 15

MORDEY. 1887
AA. EXCITING COILS.
A′A INDUCTOR POLES.
BB. INDUCED COILS.

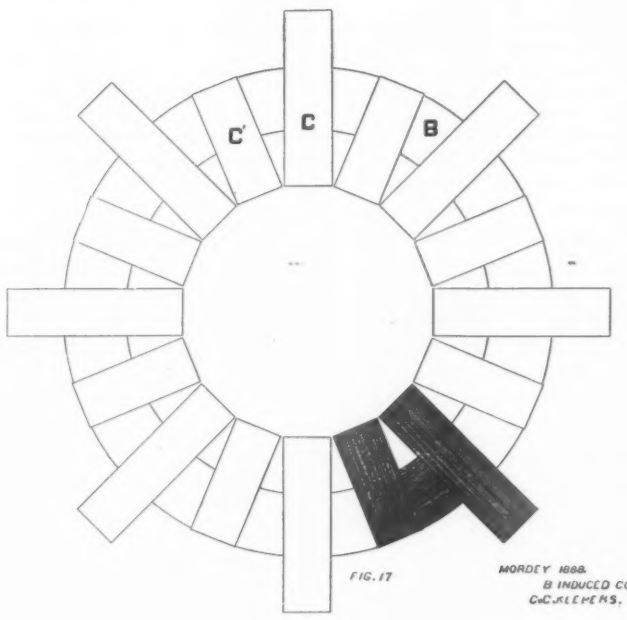


FIG. 17

MORDEY 1888.
B INDUCED COILS
C C′ KEEPERS.

because of its space variations. With a low armature reaction, such losses will be extremely small.

Mordey's success, instead of putting an end to attempts to build inductors with iron in the induced portions, gave rise to a new series of efforts. Indeed, Mordey himself was foremost. His English patent of 1887, relating to the coreless armature machine, also described a machine with cores, and in subsequent patents he describes the machines shown in Figures 17, 18, 19 and 20.

These machines have not come into use, and, presumably, they are not as satisfactory as the coreless machine. Yet they show a marked advance when compared with the older machines. The use of the short-circuiting the magnetic connections between the inducing and induced cores are alternately reversed by the rotating keepers C. The whole of the iron in the machine appears to be subject to hysteresis loss. Foucault currents are checked in the usual manner by lamination. In this machine, if the induced coils are so wound that they may be worked in parallel, it is possible to

reduce the iron losses in proportion to the load by cutting out both inducing and induced coils in the same degree. I hardly think that this advantage is sufficient to countervail, having the hysteresis loss too high to begin with. A few of these machines were put into practical use, but I think not many.

The machine designed by Rankin Kennedy in 1890 is a twinned form of the Mordey, shown in Figures 17 and 18, with the short-circuiting pieces C' left

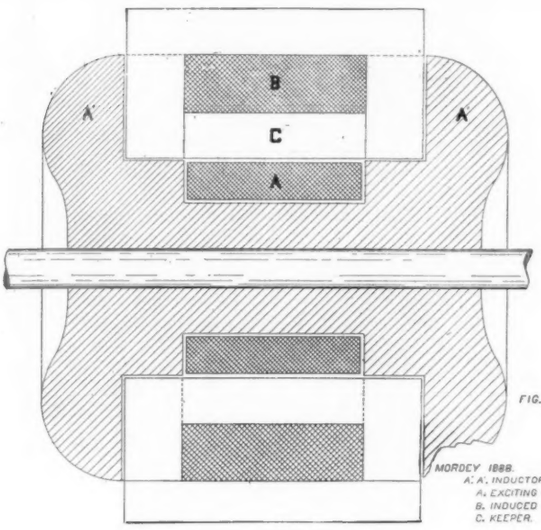


FIG. 18

MORDEY 1888.
A', A'. INDUCTOR POLES.
A. EXCITING COIL.
B. INDUCED COIL.
C. KEEPER.

out. This necessitates the lamination of the whole of the iron, and subjects it all to hysteresis loss. The twins are so arranged that the induced electromotive forces in the inducing coils are in opposition, so as to prevent the development of alternating currents in the inducing circuit. The machine has not, I think, been practically introduced, and in my judgment it is less fitted for use than its prototype.

The modern machines thus far described lend themselves badly to polyphase working. This is true even of the standard Mordey, while as to the others, adaptation to polyphase means practically duplication or triplication of the whole machine. As polyphase machines, they are merely mechanical combinations of single phase machines. A machine adapted directly to polyphase working, on the other hand, regulates more closely and is more efficient

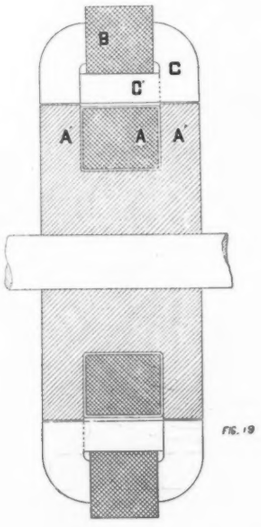


FIG. 19

MORDEY 1889.
A. EXCITING COIL.
A'A' INDUCTOR PULS.
B. INDUCED COILS.
CC' KEEPERS.

as a polyphase than as a single-phase machine. The machines that follow are all suitable for polyphase.

The first of them, Figures 22 and 23, is due to one of the masters of our profession in this country, and would even on this account alone be worthy of attention. But mechanically, in the robustness and simplicity of design, it seems well in advance of its predecessors. The induced coils are well secured

and out of harm's way, and the only moving pieces in the machine are the shaft and the single star-shaped inductor. The adaptation of the machine to single, two or three-phase working is merely a matter of the number and grouping of the induced coils. The duplication of the exciting coil is not, I think, to be considered an improvement. High hopes were entertained of the future of this machine. Of the causes of their frustration it is not for me to speak.

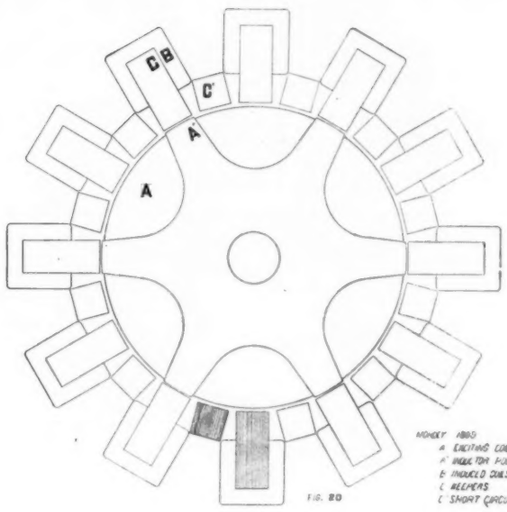


FIG. 20

MORDEY 1889
A EXCITING COIL
A' INDUCTOR PULS
B INDUCED COILS
C KEEPERS
C' SHORT CIRCUIT KEEPERS.

The operation of the Pyke and Harris machine will be clear from the drawings, Figures 24 and 25. The machine consists of a pot magnet with a central core. At the bottom of the pot lies the inducing coil A. The lip of the pot and the core carry inwardly and outwardly projecting laminated polar extensions which support the induced coils B. Between these polar extensions move the rotary laminated keepers C. What I have called keepers here, on account of their appearance and size, really correspond to the inductor in the Thomson machine, and in that which follows, for they normally constitute that portion of the machine in which the flux is most invariable. There is no reason why a machine of this form should not be all right electrically if well designed. Mechanically, however, it seems to sacrifice that very simplicity which makes inductors desirable.

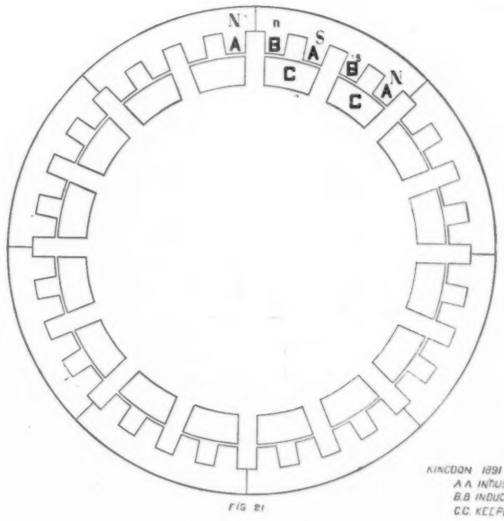


FIG 21

KINGDON 1891
A A. INDUCTORS.
B B. INDUCED CORES.
C C. KEEPERS.

I now come to the machine with which I am best acquainted, and in whose designing I took part. For these reasons I may be pardoned for going more into detail in the description, since they enable me to give more information. Coming after that of so many able engineers, it is scarcely to be expected that the work of my colleagues and myself should result in any startling change in form, and, in fact, our improvements are not such as to catch the eye.

They, however, have made the induction alternator with iron-cored armature a success; so much so, that I have no hesitation in saying that the inductor is not only the alternator of to-morrow, but that it is the alternator of to-day.

Figures 26 and 27 show clearly the construction of the machine. The rotary inductor is a cylindrical steel casting with outwardly projecting, laminated pole pieces at either end. The armature consists of two rings connected by wrought-iron tie bars. The induced coils are sunk below the surface in grooves in the armature rings, and the stationary exciting coil lies in the space between the pole-pieces and the armature rings. The machine is very effectively ventilated by means of openings in the middle of the inductor under the exciting coil and the spaces between the tie bars. The exciting coil itself is protected from injury by a massive hollow ring of cast copper, inside which it is wound.

I have already called attention to the importance of keeping the flux constant in the inductor, so as to avoid hysteresis and Foucault-current losses therein. The only thing tending to disturb the inductor flux is the varying reluctance caused by change in the relative position of the armature slots and the inductor poles. To keep this at a minimum is the chief reason for preferring a double wreath of induced coils to a single one. Mechanical interruption at both ends is necessary in either case, and it is wise to take advantage of it in distributing the induced coils. With the same amount of wire, the space variation of reluctance is much less when both air-gaps are utilized than when only one is, and, at the same time, the regulation of the machine is better. As complete lamination of the body of the inductor is difficult, even a slight change of flux is to be sedulously avoided. Lamination of the pole-pieces is necessary, even with constant flux, as the slots necessarily change its distribution.

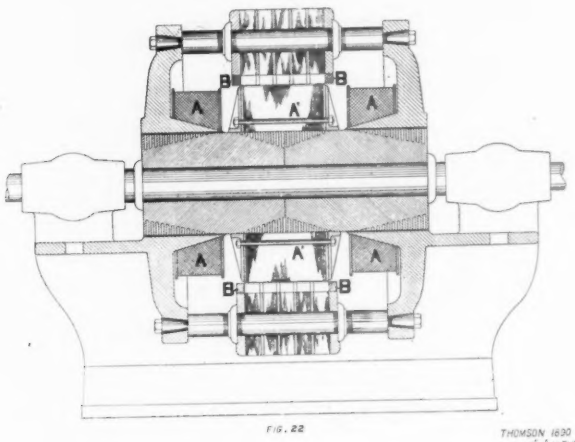


FIG. 22

THOMSON 1890
A'A' INDUCTOR POLES.
AA. EXCITING COILS.
BB. INDUCED COILS.

But, even with the flux through the inductor constant, the difficulties are by no means surmounted. A large mass of iron in the armature is a necessity of the construction, and the losses in this way may be such as to make the machines practically inoperative. Only thorough lamination would put an end to the Foucault losses, and thorough lamination is, for structural reasons, out of the question. Another solution is imposed. Now, when the flux is constant in the inductor, it is obvious that in amount it must also be constant in the armature. It but shifts in position without altering in magnitude. But to give rise to the electromotive force in the induced coils, it is unnecessary that the shift should take place throughout the mass of the armature. It is necessary only that the shift should take place through the coils; that is, to the depth to which the coils are embedded. The problem is, therefore, to combine a steady flux in the center of the armature with a shifting flux in the armature faces; or, in other words, the distribution of the flux in the middle of the armature must be independent of the points in the faces at which the flux enters. Stated in this way, an analogy with the conditions of electrical distribution in parallel is suggested, and this points to the solution. Consider for a moment the two laminated rings as electrical mains and the tie bars as translating devices. Then, if the two mains be of low and the translating devices of high resistance, the current through the translating devices will be substantially independent of the points of attachment of the feeders—the analogues of the inductor poles. Similarly, if the reluctance in the direction of the lamination be low in comparison with that in the

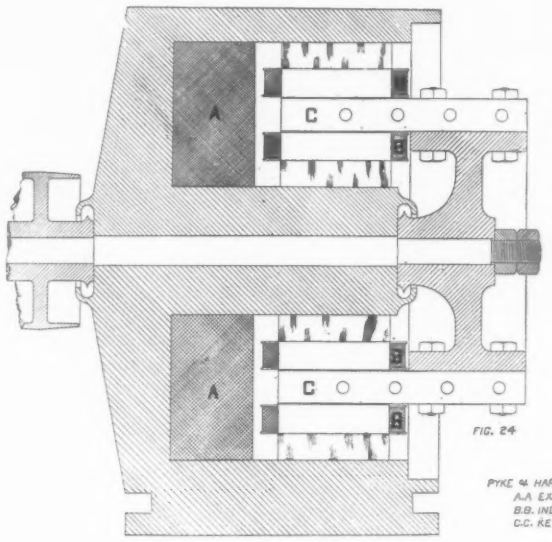


FIG. 24

PYKE & HARRIS, 1892.
A.A. EXCITING COILS.
B.B. INDUCED COILS.
C.C. KEEPERS.

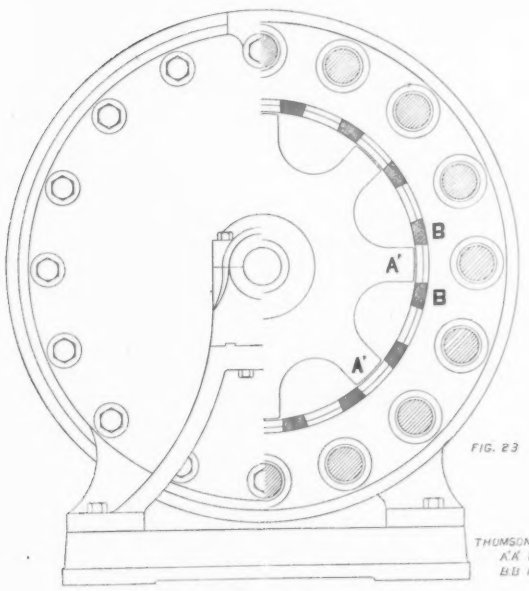


FIG. 23

THOMSON 1890
A'A' INDUCTOR POLES.
B.B INDUCED COILS.

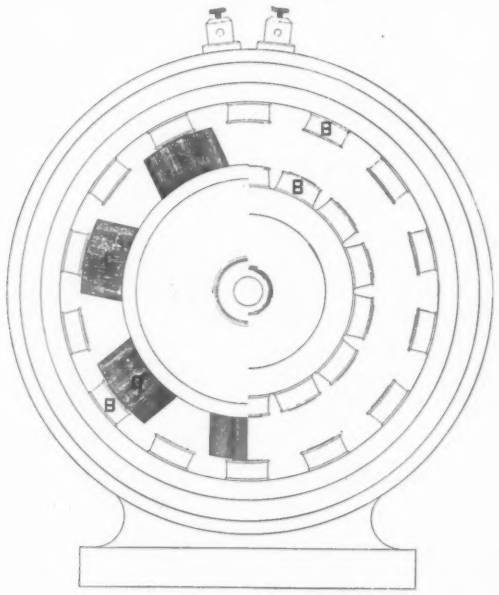


FIG. 25

PYKE & HARRIS, 1892.
B.B. INDUCED COILS.
C.C. KEEPERS.

direction of the tie bars, the magnetic flux in each bar will be constant, no matter what the position of the inductor poles. In this manner, the change of flux is confined to a small portion of the armature iron, which may be thoroughly laminated, and thus Foucault-current losses are suppressed and hysteresis losses reduced to a minimum. It thus becomes possible to use in the armature any quantity and form of iron demanded for structural reasons.

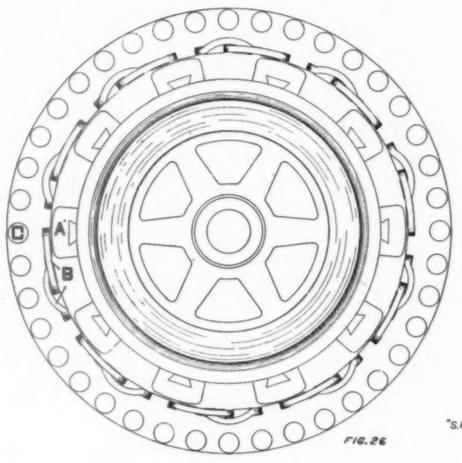


FIG. 26

"S.K.C." 1893
K INDUCTOR POLES.
B INDUCED COILS.
C KEEPERS.

It will be noticed that the inductor poles are curved in a special manner. This is done to make the electromotive force curve as nearly as possible a sine curve. You will remember that some time ago much space was given up in the electrical journals to a controversy as to the best form of electromotive force wave. Nearly every form of wave found some advocate for some purpose, but somehow the sine wave seemed always to be second best. As we are building machines for general service, we are entirely satisfied with that curve which is second best for each special purpose, believing it to be in consequence the best for general distribution work.

The heavy copper bobbin surrounding the exciting coil, besides being a mechanical protection for the coil, is also of use in that it prevents the development of an excessive electromotive force in either exciting or induced coils, if the exciting circuit should be accidentally broken. It resists very powerfully any sudden change of flux.

An important advantage of all stationary induced-coil machines, and, of course, therefore, of inductors, is the possibility of regulating separate circuits or feeders with little or no auxiliary apparatus. Since it is possible to tap the armature coils at any point, any desired electromotive force between zero and the maximum may be obtained for one circuit without altering the excitation, and, consequently, without interfering with the electromotive force of any other circuit. Circuits or feeders having different drops may thus be provided for. Figures 28 and 29 show two methods of operation. The coils AA in the first are the main inducing coils, giving the electromotive force necessary for all circuits or for the mains in a feeder and main system. BB are the auxiliary or regulating coils.

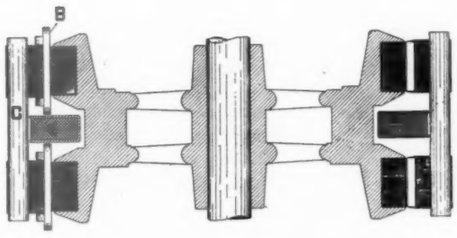


FIG 27

"S.K.C." 1893
A EXCITING COIL.
A' INDUCTOR POLES.
B INDUCED COILS.
C KEEPERS.

The number of the regulating coils in circuit is controlled by the switches CC. The diagram shows only two circuits; but, of course, any number may be branched on, each with its own regulating switch. This method is the simpler for the operation of only one or two machines. With a larger

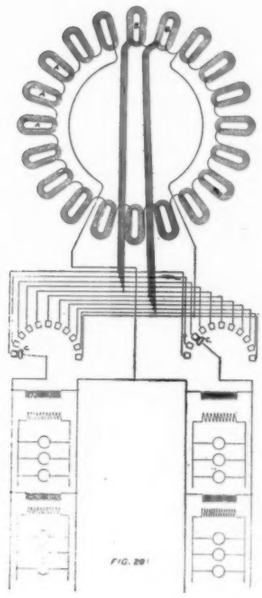


FIG. 28

number of machines I would recommend the method shown in Figure 29, as it gives simpler switch connections. In this method, the auxiliary induced coils do not act directly upon the circuits, but only through the intermediary of the auto-converters D. This method of regulation has the advantage over the ordinary "booster" system that the auto-converter D has, for the same regulation needs to be only one-half the size of the corresponding "booster," and it is, besides, more efficient. The adoption of either method secures the same

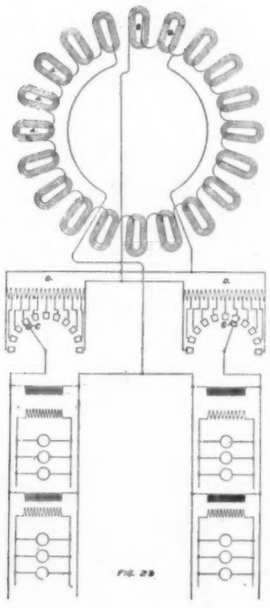


FIG. 29

flexibility and ease of control of the individual circuits as if a separate machine were used to feed each one, while, at the same time, we get the lower first cost and greater economy of operation of large machines.

STEAM BOILERS: THEIR EQUIPMENT AND MANAGEMENT.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, MAY 7, 1896, BY ALBERT A. CARY.

One of the first considerations to be taken up in designing a new boiler plant is found in the question, "What style of boiler is best adapted to our work?" And after this is answered the other question following closely at its heels is, "Are our available funds sufficient to equip this plant with the chosen form of boiler?" Unfortunately, we find by no means a small percentage of prospective steam users asking these questions in the reverse order, and it is due largely to this fact that we find so many tank-makers in the boiler business, so many coal companies flourishing and growing rich at the steam-users expense, so many boiler insurance companies springing up in every section of the country, to say nothing of the profits of the owner of the boiler, which unnecessarily go to keeping the boiler plant in repair and the coal pile replenished. All these troubles do not result from the doings of the "penny wise, pound foolish" man, but there is also a large percentage of the plants erected where ignorance has been the partner of the designer, and we find the outsiders again reaping the profits which properly belong to the victim.

After many years of close contact with steam-users, I have been led to believe that there is no branch in engineering in which more money is foolishly spent, due to the ignorance of the purchasers, than in steam plants, especially those of small size, say from 300 horse-power down.

I have met many manufacturers who are bright, practical, mechanical men, understanding their business in all its details to a degree that commands your admiration, but when it comes to their steam plant, alas, how little they know, although they think, in their own conceit, that they have mastered this "easy subject" way back in their early days and there is nothing left for them to bother themselves with, and nine times out of ten you will hear them boast that their steam plant is a model one in every respect.

In these very plants you often will find smoky chimneys painting the whole neighborhood with foulness, and not a single attempt is made to stop this. You will find many of these boilers filling up with scale, and this is calmly accepted as a necessary evil. You will find miserable firemen wasting coal, and so I might continue this list of unnecessary evils to a considerable length.

In many of this class of plants no effort is made to determine the actual amount of power used, unless by a very popular process called guessing, and this extremely delicate operation is often left to the man who opens the throttle or shovels the coal under the boiler. He, naturally, wishing to show up in the best possible light, often decides upon a pretty high figure which I have on more than one occasion been forced to lower by a large percentage after conducting a careful test. This man, after finally deciding upon the amount of power he thinks the plant is taking, carries these figures to "the boss." Then follows a lot of profound figuring, and finally it is shown that the steam plant is wonderfully efficient, and often the boiler is found to be evaporating something like 16 pounds of water to a pound of coal, and all of the owners and attendants of the plants in the neighborhood are made envious over these wonderful results.

From such false results as these, the excessive amounts of coal used in these plants is considered a remarkably low consumption for the "very large amount of power developed," as has been determined by the guessing process. The owner settles back perfectly contented with his steam plant and then all progress and improvements stop. His self-satisfied ignorance and boasting finally induces his neighbor (who knows just as much about steam plants as he does) to put a similar plant in some new mill he is building, and so the installation of inferior steam plants continues and becomes almost epidemic.

There is no one who enjoys and profits more by this state of affairs than the coal dealer. He stocks up with all kinds of coal, good, bad and indifferent. He furnishes the class of steam users we have described with anything and everything in the coal line and gets good prices for what he is selling, but this is not the condition of affairs in up-to-date plants, designed and managed by competent engineers. The coal dealer knows that in these plants the amount of coal used and water evaporated is continuously kept account of, and as an inferior coal will evaporate less water than the good, pound for pound, he knows that a delivery of inferior coal will be detected at once and it will cost him a customer if he is not very careful.

Now, to return to the equipment of our new boiler plant, and consider the matter of selecting the best boiler adapted to our use. This is a somewhat weighty question, and unless we are thoroughly posted in the practice of to-day, we had much better hire a competent engineer to make this decision for us, and the money paid to him will, in the end, be found to be an excellent investment.

There is probably no branch of trade employing abler men to discuss the merits of their output and sell their product than is found in the boiler business, and I am really forced to pity the inexperienced purchaser who is not perfectly capable of forming his own individual opinion of the relative merits of the various boilers offered to him and their adaptation to his use. Such a man is very apt to be influenced by the words of the smoothest talker, or the one who tells him his "story" last, and in the end he is pretty sure to make a serious mistake by selecting a boiler very poorly adapted to the service it is intended for, or one far inferior to the boiler he started out to buy.

I am sure that those present who have passed through this ordeal will bear me out in these statements, and this merely emphasizes what I have said before; that is, that if you were not thoroughly competent to select one of the many boilers, hire a good, able mechanical engineer, one experienced in boiler practice, and let him decide for you. I do not mean by this that you want a man who knows simply one make of boiler and uses it for every plant for which he is retained. There are too many men of this kind, unfortunately, and by the narrowness of their decision they prove that they are incapable of judging the respective merits of the various steam boilers offered to them. Such men are apt to make you pay exorbitant prices, or else they are apt to give you something you really do not want, and they prove in this way that they are not worth their hire. In selecting the best type of boilers for a certain specific use, the conditions under which it is to be run, of course, must be considered. To cite a few examples: Let us first take up the case of a boiler to be used in a rolling-mill, where we find a long line of connected rolls running across the middle of the mill, with a large reversing engine connected at one end, in most cases by gearing. This engine, we generally find, has a cylinder of large diameter and a comparatively short stroke. We find lacking some of those refinements in valve gear which promote economy in the engines used for other purposes, and, in consequence, we find these engines calling for from 50 pounds of steam upward for each horse-power developed. These engines are frequently started up with the full load on, taking steam about the entire length of their stroke, and making the severest kind of a demand on the boiler for a supply of steam which is required to furnish this large amount in a very short space of time. In such a case as this the boiler must be of such design that it will deliver a very large quantity of steam in a very short space of time, and this may be accomplished in several ways; viz., first, by having a boiler with an abnormally large steam space; second, by having a boiler with a large water capacity and a moderate-sized steam capacity; third, by having large hot-water storage cylinders to supplement the quantity of water held in the boiler; fourth, by running the boiler at a steam pressure several times higher than that used at the engine and delivering the steam through a very large reducing valve, which reduces and delivers the steam from the high pressure to the pressure required at the engine.

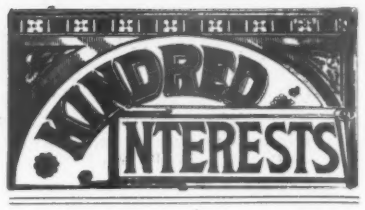
(To be continued.)

Graphite in Electrical Industries.

Graphite, which is one of the forms of carbon, and more generally known as plumbago or black lead, has come to be an important factor in electrical industries. It is a graphite crucible which is used for electrical smelting, and it is a graphite pencil or rod which is used as an electrode in the process of electrical smelting. It is graphite pulverized to an impalpable powder that is used in electrolytic work by the copper smelters. Pure flake graphite is also used for lubricating cylinders and bearings of engines and dynamos, and the same material also forms the pigment for protective paints for trolley poles, electric light poles and roofs of dynamo plants and trolley car sheds. Graphite would therefore seem to be a very important factor in electrical industries. During the last year or two the demand has very greatly increased for graphite resistance rods. Unlike German silver, it is not necessary to take into account the factor of quantity. For instance, a six-inch rod one-fourth inch in diameter may be made to have one ohm resistance or 10 ohms, or 1,000 ohms, or, in fact, almost any resistance that the electrician may require. The only reason for changing the dimensions of such rod would be either convenience or for radiating the heat when it is necessary to carry a current of considerable quantity at high resistance. The Joseph Dixon Crucible Company, of Jersey City, N. J., which was the originator of the graphite industry, and is now the most extensive miner, manufacturer and importer of graphite, has paid particular attention to the requirements of electrical engineers and is supplying the electrical industries with large quantities of material.

Niagara Falls Calcium Carbide Plant Started.

The plant of the Acetylene Light, Heat and Power Company was started at Niagara Falls, N. Y., on April 27, in the manufacture of calcium carbide. This factory is located on the lands of the Niagara Falls Power Company, and at present 1,000 horse-power is used.



Mr. Frank H. Stewart, of Frank H. Stewart & Company, the supply house, of Philadelphia, has been in New York several days this week.

The Helios Electric Company, Philadelphia, has recently issued a well prepared pamphlet illustrating the Helios standard arc lamp for direct and alternating currents.

The offices of the Valentine-Clark Company, of Chicago, dealers in poles for overhead wiring, have been moved from the Rookery to 804–5 Gaff Building, 236 La Salle street, Chicago, Ill.

J. A. Le Roy announces that he is prepared to manufacture an improved aluminum fluoroscope and also Roentgen-ray apparatus complete. Mr. Le Roy is located at 143 East Thirteenth street, New York.

W. R. Ostrander & Company, manufacturers of electric and speaking-tube goods, have removed to No. 22 Dey street, New York city. This company is one of the oldest in the business and very widely and popularly known.

The Beacon Lamp Company, of Boston, Mass., the well known makers of incandescent lamps, are manufacturing high-grade X-ray tubes. Prospective purchasers of these tubes will find it to their interest to communicate with the Beacon company.

The Grutting electric soldering iron and curling-iron heaters are rapidly becoming recognized as standard goods. The Electric Appliance Company, of Chicago, as general western agents, are carrying a stock of these goods, which are meeting with ready sale.

The Electric Appliance Company's complimentary duplicate order book advertising scheme has proven to be a big success and the books are much appreciated by their customers. The Electric Appliance Company, Chicago, still have a number of books left, which will be sent free on application.

The new watch-case receiver of De Veau & Company, New York, is receiving many words of praise from users. These practical telephone men are satisfied that they have the best thing of the kind that can be made. Their new catalogue is now ready for distribution, and every one interested in telephones should send for it.

The Goubert Manufacturing Company has opened a Western office at 203 Monadnock block, Chicago, Ill. These western headquarters are required through the increase of business for the Goubert company in that section of the country. The new offices will be in charge of Mr. E. Webster, who is well known in engineering circles and is an expert in the matter of steam appliances. He was for many years with the Stillwell-Bierce and Smith-Vaile companies, of Dayton, Ohio.

ELECTRICAL PATENTS

ISSUED MAY, 5, 1896.

559,711 Marine torpedo; L. F. Johnson, W. J Slacke and H. Lacy, Easton, Pa.—A torpedo shell having an electro-magnet mounted within the shell and at the bow thereof, such magnet having curved pole pieces conforming to the converging lines of the shell, whereby the torpedo may be attracted to and held against the hull of an iron or steel vessel.

559,633 Safety appliance for elevators; J. H. Tennyson, New York, N. Y.

559,648 559,649 Electric arc lamp; Malone Wheless, Washington, D. C.

559,692 Armature for electric motors and dynamos; J. P. Fiske, Alliance, Ohio—An armature core or drum having annular extensions at its ends, a series of coils disposed on said core or drum and having their ends disposed on said annular extensions.

559,701 Conduit for electric lines; J. Graizier, Geneva, Switzerland.

559,721 System of electrical distribution; B. G. Lamme, Pittsburgh, Pa.

559,752 Electric arc lamp carbon; J. Roubal, Prague, Austria-Hungary.

ISSUED MAY 12, 1896.

559,792 Electric switch; W. W. Dean, St. Louis, Mo.

559,796 Electrically operated railway switch; A. C. Goetz, Milwaukee, Wis.—An insulating section for an electric line, consisting of a block of insulating material, to one edge of which the electric line is attached, and having a short wire attached to its oppo-ite edge, said short wire insulated by the block from the main line.

559,801 Electric light for bicycles; B. B. Hoffman, New York, N. Y.—A lantern case containing a reflector and lamp socket, the reflector being held in place by the lamp bulb.

559,821 Telegraphic printing apparatus; H. C. Spaulding, Boston, Mass.

559,837 Electric telephone transmitter; N. Bassett, Philadelphia, Pa.—Consists of a diaphragm, fixed terminal electrodes and a movable electrode which bridges said terminal electrodes and is in electrical contact therewith and which bears or presses against the diaphragm.

559,863 Electric arc lamp; S. E. Nutting, Chicago, Ill.—In constant potential lamps, the combination of an arc drawing magnet, a shunt circuit around the arc, and means operated by the magnet for varying the resistance of the shunt circuit around the arc.

559,869 Selective signal and lock-out system; C. E. Scribner, Chicago, Ill.—A telephone line having at two or more substations lock-out boxes adapted to be set by current from a battery connected with the line, a key adapted to short-circuit the lock-out boxes to suspend their operation.

559,872 System of electrical transportation; P. K. Stern, St. Louis, Mo.—Consists of a route or line of travel, a vehicle which is adapted to travel along said line, a primary inducing element, which is arranged along said route, and a laminated wheel, mounted on said vehicle, which wheel is influenced by the primary element.

559,874 Telephone system; W. F. Taylor, Montreal, Can.

559,903 559,904 Electrical steering gear; M. Pfatischer, Philadelphia, Pa.

559,907 Running-compound wound generators in multiple; W. B. Potter, Schenectady, N. Y.—The means for adjusting the compound effect of generators operated in multiple, consisting of a shunt around the series circuit of each of such machines, the shunt being substantially equal in resistance to the resistance of the series coil and its adjusting resistance.

559,910 Armature for dynamo electric machines; H. G. Reist, Schenectady, N. Y.—An armature spider for a dynamo-electric machine, comprising a central boss or hub, separate arms radiating therefrom, the arms having expanded faces and dove-tail grooves in the expanded faces.

559,913 Alternating current system of distribution; C. P. Steinmetz, Schenectady, N. Y.—Comprises transformers having their primaries connected in delta and their secondaries in Y, and a neutral or equalizing wire extending from the common junction of the secondaries only.

559,916 Electric switch; P. G. Tismer, New York, N. Y.

559,939 Electric cigar-lighter; W. Fisher, Chicago, Ill.

559,988 Telephone; T. Berdell, New York, N. Y.—A diaphragm mounted in a magnetic field in a position of magnetic equipoise or stable equilibrium.

559,989 559,990 Telephone; T. Berdell, New York, N. Y.

560,006 Dynamo electric machine or electric motor; O. Patin, Paris, France.

560,023 Thermostat; W. G. Day, Baltimore, Md.

560,027 Barrel or package register; E. Friedman, Dobbs Ferry, N. Y.—A track for the packages, a movable bar adjacent thereto, and adapted to be actuated by passing packages, an arm pivoted to the bar, a centering spring or springs for retaining the arm in position, a register and a register-controlling device actuated by the arm.

560,031 Electric railway; J. H. Guest, Boston, Mass.—Consists of a series of actuating coils, a core traveling in a circular path through the same and provided with a longitudinal strip of good conducting material and the series of circuit-closers adapted to engage with said strip.

560,035 Electric regulator; R. M. Hunter Philadelphia, Pa.

560,039 Electric arc lamp; A. O. Mackin, Anderson, Ind.

REDUCED RATES TO ST. LOUIS.

The Republican National Convention will meet in St. Louis, June 16. For this occasion the B. & O. R. R. Co. will sell Excursion Tickets from all stations on its line East of the Ohio River for all trains June 12 to 15, inclusive, valid for return passage until June 21, at one fare for the round trip.

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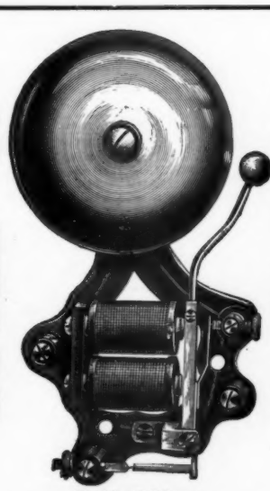
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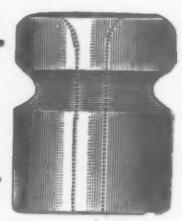

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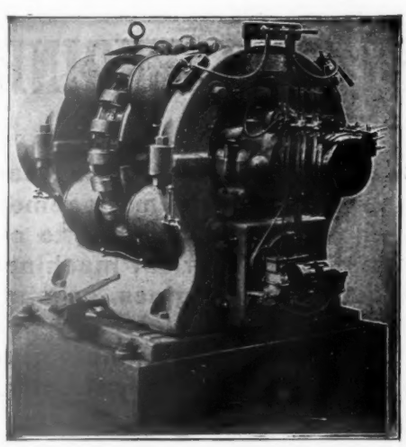

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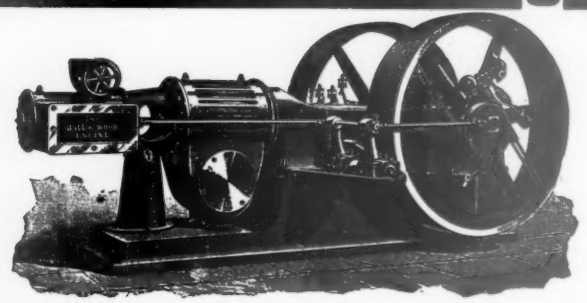

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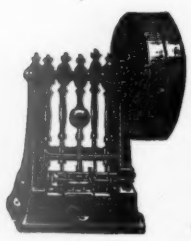

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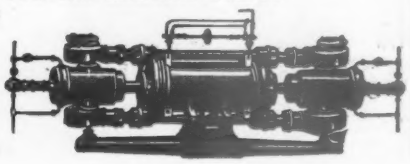

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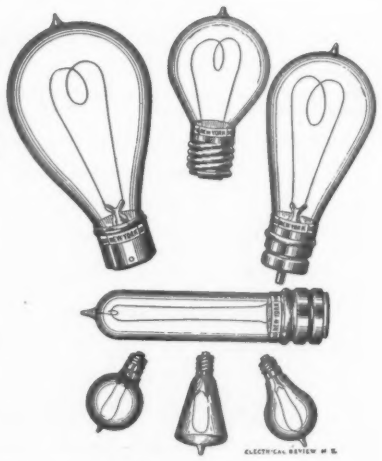

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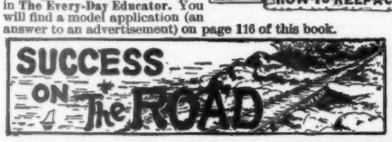

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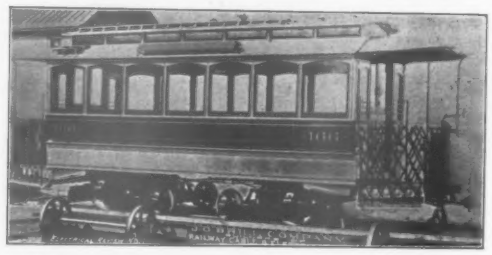

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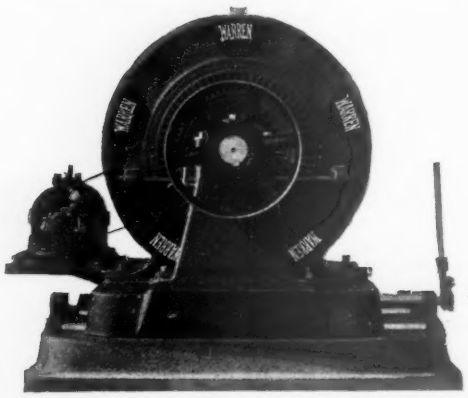

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